BIENNIAL REPORT

INSTITUTE OF VERTEBRATE BIOLOGY

ACADEMY OF SCIENCES OF THE CZECH REPUBLIC

2005–2006
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PREFACE

I am glad to introduce this traditional report summarizing the main results of scientific activities of the Institute during the last two years. The most important event in this period was the transformation of the Institute into a public research institution. This process was completed at the end of 2006.

The Academy of Sciences of the Czech Republic has undergone profound changes in relation to varied scientific and organisational aspects since its foundation in 1993. This transformation included also human resources and the Academy has become a modern, democratically administrated cluster of autonomous, non-university research institutes. The institutes of the Academy of Sciences were state contributory organisations, which was quite unusual legal form within the European Union. The legal subjectivity of the institutes was restricted, and this fact weakened their independency in respect of both the economic area and the cooperation with other subjects.

The acceptance of Act No. 341/2005 Coll. on Public Research Institutions made it possible to remove these deficiencies. The act introduced a new form of legal entity – a public institution, with principal activities in the research area and with significant provision of an infrastructure for research. Besides the main research performance, the Institute may now realize also secondary and other activities for profit, subject to legal restrictions.

After January 1, 2007, further transformation steps follow. The members of the Council of the Institute have been elected, and public competition for the post of the director has been announced. All these changes will certainly have a profound influence on the life and the research performance of the Institute in the future.

The last two years can be considered fruitful for the Institute and its staff. The fellows were particularly successful in raising funds for grant projects. The institutional budget assigned from the state contribution in the frame of the Institutional Research Plan achieved approximately 22 and 23 million CZK in 2005 and 2006, respectively. Additional 14 million CZK were provided in both the years for investment into laboratory equipment and maintenance of buildings. Research grants and diverse contracting funding contributed to the budget with 16 and 26.5 million CZK in 2005 and 2006, respectively.

In the previous two years, the Institute employed 61 fellows paid from the institutional sources, and additional 36 fellows were contracted on the basis of research grant funding. In the respective period, 18 foreign workers were employed.

The scientific achievements of the Institute are summarized in the list of publications. Altogether, 267 scientific contributions authored by the fellows of the Institute were published in 2005–2006. Almost 100 papers appeared in international journals included in databases of the Web of Science. The total impact factor of these publications was 69.7 in 2005 and 67.1 in 2006, what indicates a remarkable increase in comparison with 2003 and 2004 (total impact factor of 40.4 and 46.9, respectively). I hope the Institute will continue this successful development towards research excellence also in the next years.

Jan Zima
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Ing. Petr RAB, DSc  
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Assoc. Prof. RNDr. Zdeněk REHÁK, PhD  
(Masaryk University, Brno)
RESEARCH PROJECTS

Institutional Research Plan


Projects supported by the Grant Agency of the Academy of Sciences of the Czech Republic

IAA6093403 Evolutionary determinants of brood parasitism in ducks – P. Musil (Charles University, Prague), M. Honza (IVB AS CR), 2004–2008
IAA6093404 Species diversity and ecology of selected West African vertebrates – P. Koubek (IVB AS CR), M. Gelnar (Masaryk University, Brno), P. Hejcmanová (Czech University of Agriculture, Prague), 2004–2008
IAA600930605 Evolution of antiparasitic strategies of selected hosts towards avian brood parasitism – M. Honza, 2006–2010
IAA600930608 The role of MHC in sexual selection – observational and experimental study in three model vertebrate species – J. Bryja (IVB AS CR), A. Šimková (Masaryk University, Brno), 2006–2008
IBS5045111 Molecular and other genetic markers applied in conservation of populations of endangered, rare and vanishing fish species in the Czech Republic – P. Ráb (Institute of Animal Physiology and Genetics AS CR, Liběchov), V. Lusková (IVB AS CR), 2001–2005
KJB600930508 European reed warbler populations across a migratory divide: insights into migration by analyses of DNA sequences, stable isotopes and ringing recoveries – P. Procházka, 2005–2007
KJB600930613 Diversity of cultivable microorganisms of ixodid ticks, recognized vectors of vertebrate pathogens – I. Rudolf (IVB AS CR), P. Švec (Masaryk University, Brno), 2006–2008

Projects supported by the Grant Agency of the Czech Republic

GA206/03/0726 Ecology of emerging arthropod-borne microorganisms - Z. Hubálek, 2003–2005
GA206/03/0757 Assessment of population size and population structure of Eurasian otter (Lutra lutra) in different habitats by a non-invasive genetic method - J. Zima, 2003–2005
GA206/04/2003 Ecological interactions in populations of small rodents - E. Tkadlec (Palacký University, Olomouc), I. Pavlik (Veterinary Research Institute, Brno), M. Heroldová (IVB AS CR), 2004–2006
GA206/06/0851 Extra-pair fertilizations and the strength of sexual selection in socially monogamous passerine - T. Albrecht (IVB AS CR), P. Muclinger (Charles University, Prague), 2006–2008
GA206/06/0953 Phenotypic plasticity of thermal physiology traits in newts - L. Gvoždík, 2006–2008
GA206/06/0954 Intraspecific variability of populations of two cryptic bat species of genus Pipistrellus in Central Europe - Z. Řehák (Masaryk university, Brno), J. Bryja (IVB AS CR), 2006–2008
GA206/06/0955 Genetics - J. Piálek, 2006–2008
GA524/03/0061 Comparative studies on dracunculoid nematodes, with special reference to agents of serious diseases of fish - F. Moravec (Institute of Parasitology AS CR, České Budějovice), V. Baruš (IVB AS CR), 2003–2005
GA524/04/1115 Fluctuating asymmetry in fish parasites: a new approach to assess environmental stress of aquatic ecosystem? - B. Koubková (Masaryk University, Brno), M. Machala (Veterinary Research Institute, Brno), P. Jurajda (IVB AS CR), 2004–2006
GA524/04/1128 MHC class IIB genes of European cyprinid fish: their genetic variability and evolution in relation to the host life-history traits and parasitism - A. Šimková (Masaryk university, Brno), P. Jurajda (IVB AS CR), 2004–2006
GA524/06/0687 Importance of red fox in different ecosystems of Central Europe - J. Červený (IVB AS CR), M. Anděra (National Museum, Prague), K. Šťastný (Czech University of Agriculture, Prague), 2006–2008
GD524/05/11536 Evolutionary ecological analysis of biological systems: research center for PhD studies - M. Chytrý (Masaryk university, Brno), P. Jurajda (IVB AS CR), 2005–2008
GP206/03/P134 Feeding strategy of large herbivore mammals between forest and field habitats - J. Kamler, 2003–2005
GP206/06/P152 Reproductive isolating mechanisms in *Nothobranchius* fishes (Aplocheilidae) – M. Reichard, 2006–2008

GP206/06/P302 Genetic structure of black grouse populations in the Czech Republic – J. Svobodová, 2006–2008

GP524/05/P291 Parasitism and invasive species: effect of parasite infection on the biology of *Neogobius kessleri* in its native and introduced range – M. Ondračková, 2005–2006

Projects supported by the Ministry of Agriculture

GAZV QF3028 Development of new technologies of rearing commercially important riverine species of fish and crayfish endangered by environment degradation – P. Kozák (University of South Bohemia, České Budějovice), J. Barthová (Charles University, Prague), P. Spurný (Mendel Agriculture and Forestry University, Brno), S. Navrátil (University of Veterinary and Pharmaceutical Sciences, Brno), M. Prokeš (IVB AS CR), 2003–2007

GAZV QF3029 Harmonization with the EU in application of the principles of pharmacovigilancy in aquaculture in the Czech Republic – V. Piačková (University of South Bohemia, České Budějovice), J. Hajšlová (Institute of Chemical Technology, Prague), Z. Svobodová (University of Veterinary and Pharmaceutical Sciences, Brno), M. Prokeš (IVB AS CR), T. Barth (Institute of Organic Chemistry and Biochemistry AV CR, Prague), 2003–2007

GAZV QF4192 Methodology of evaluation of damages caused by game to field crops – J. Kamler (IVB AS CR), J. Dvořák (Mendel Agriculture and Forestry University, Brno), 2004–2006

Projects supported by the Ministry of Environment


Management plan of large carnivores (brown bear, wolf, lynx) in the Czech Republic – P. Koubek, 2003–2005

Projects supported by the Ministry of Education, Youth and Sport


LC06073 Biodiversity Research Center – P. Kindlman (Institute of Systems Biology and Ecology AS CR, České Budějovice), and other seven partners, including J. Zima (IVB AS CR), 2005–2011

International projects

European Union – 6th Framework Programme

**Integrated project EDEN** (no. 010284-2) Emerging diseases in a changing European environment (coordinated by CIRAD Montpellier, France) – Z. Hubálek, 2004–2008

Integrated consortium on ticks and tick-borne diaseases (ICTTD - 3) - L. Grubhofer (Biology Center AS CR, České Budějovice), Z. Hubálek (IVB AS CR), 2004–2008

Marie Curie research training network SEXASEX (no. MRTN-CT-2004-512492) Sex to asex: a case study on transitions and coexistence between sexual and asexual reproduction (coordinated by the Royal Belgian Institute of Natural Sciences, Belgium) - J. Zima, 2004–2009

Marie Curie intra-European fellowship PHYLOMICROTUS (no. 24956) Phylogeography of the Orkney vole Microtus arvalis orcadensis (cooperation with University of York, UK) - N. Martinková, 2006–2008

Project INTAS (no. 03-51-4030) A multidisciplinary study of hybrid zones in the common shrew (coordinated by the University of York, UK) - J. Zima, 2004–2007

Other EU projects

European Science Foundation Research Networking Programme Integrating population genetics and conservation biology: Merging theoretical, experimental and applied approaches - J. Bryja (member of the steering committee), 2004–2009

European Science Foundation Research Networking Programme Thermal adaptation in ectotherms: Linking life history, physiology, behaviour and genetics - L. Gvoždík (member of the steering committee), 2006–2011

Large Scale Facility Project (no. HPRI-CT-2001-00180) Intraspecific diversity in selected cyprinid fish species in the conditions of Central Europe (coordinated by the Institute of Aquaculture, University of Stirling, Scotland, UK) - J. Mendel, 2005

Bavarian Interreg-III-A Project Wildlife and human in Bavarian-Czech-Austrian border region - example of the otter (cooperation with the Bavarian Forest Institute and Technical University of Munich, Germany) - P. Hájková, 2006–2007

IUCN and European Commission Assessment of European mammal species - J. Zima (participant), 2006–2007

Bilateral projects


Programme KONTAKT (project no. 26) Zoogeography, taxonomy and phylogeography of mammals in south-eastern Europe, Asia Minor and South Africa - V. Vohralík (Charles University, Prague), J. Zima (IVB AS CR), B. Kryštufek (University of Primorska, Koper, Slovenia), 2005–2006

Programme KONTAKT (project no. 144) Variability of social system in Apodemus mice (Rodentia) - M. Stanko (Institute of Zoology SAS, Bratislava, Slovakia), J. Bryja (IVB AS CR), 2004–2005

Austrian Science and Research Liaison Office Brno Bioarchaeology of the Holocene populations of Central Europe: reconstruction of mobility and manipulative behaviour - V. Sládek (IVB
AS CR), M. Berner (Naturhistorisches Museum, Wien, Austria), P. Galeta (University of West Bohemia, Plzeň), 2006

**Integrated Bilateral Project** Development of new methods for the laboratory diagnostics of West Nile Virus disease in human and some other animals (cooperation with Istituto Zooprofilatico e Sperimentale, Teramo, Italy) – Z. Hubálek, 2004–2005

**Individual projects**

**Leverhulme Trust (UK),** project Adaptation and coevolution in an unusual symbiosis (cooperation with University of Leicester, UK) – M. Reichard, 2003–2005

**Natural Environment Research Council (UK),** project Stoats and the Irish question (cooperation with University of York, UK) – N. Martínková, 2005

**The Leakey Foundation (USA),** general grant The possible role of ciliate (*Troglodytella abrassarti*) in chimpanzee hind gut fermentation – K. Petrželková, 2006–2007.

LIST OF PUBLICATIONS

Books, textbooks, edited proceedings


Chapters in books


Papers in journals included in the databases ISI Web of Knowledge


Papers in other refereed journals


Papers in proceedings


Book reviews


Popularization books and articles

20–25.
86–94.
12–13.
10–11.
81.
16–17.
14–15.
16–17.
Jan Farkač, Praha: 105.
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Research priorities

Research is focused on the ecology of selected microbial pathogens (including new emerging diseases), the causative agents of human and animal infections. The phenomenon of natural focality is studied in respect of the role of wild endotherm vertebrates (hosts or reservoirs) and hematophagous arthropods (vectors) and under effects of the recently globally changing natural conditions.

Main research topics:
• arbo viruses (i.e. viruses transmitted by ticks, mosquitoes and other hematophagous arthropods, such as the West Nile, Sindbis, Ťahyňa, and tick-borne encephalitis viruses)
• spirochetes (Borrelia burgdorferi, the agent of Lyme borreliosis) and some other bacterial agents
• circulation of these pathogens in terrestrial and aquatic ecosystems under changing natural conditions including human impact
• development and optimalisation of a new molecular-biological methods for the detection and characterization of the pathogens studied
• prophylactic strategy establishment and prevention of free-living vertebrates and humans in relation to preventive medicine (human and veterinary), environmental protection, and nature conservation
Selected research results

Migratory birds and avian influenza A virus H5N1 – its spread in Eurasia, possible introduction to America and continental dispersal

Water anseriform birds are the reservoir of a majority of influenza A viruses, including highly pathogenic avian influenza (HPAI). Marked lethality of its H5N1 subtype seemed to limit the role of migratory birds in the dispersal. However, the situation changed as HPAI H5N1 virus has expanded rapidly across Asia and into Europe and Africa, and migratory birds contributed to this dispersal. Birds could theoretically introduce H5N1 virus to the Western Hemisphere through migration, vagrancy and translocation by people (bird trade). Vagrants and migratory birds are not likely inter-hemispheric introductory hosts; import of infected domestic or pet birds is more probable. In the case of successful introduction, the virus might spread over the continent easily, with migratory anseriform birds (swans, geese, and ducks) playing a similar role as in Eurasia.

HUBÁLEK Z., 2006: Migratory birds and influenza virus. 8th Workshop of the Southeastern European Bird Migration Network (SEEN), Prague, abstract.
Import of West Nile virus infection in the Czech Republic

We report West Nile virus infection of the central nervous system in a 69-year-old man, residing in North Moravia (Czech Republic), who visited the USA from 6 July to 31 August 2002. He developed fever with fatigue at the end of his USA stay. He was hospitalized after his return with fever up to 39.5 °C, fatigue, anorexia, dizziness, insomnia, blurred speech, and a marked bradypsychism. A significant increase of antibodies neutralizing West Nile virus was detected between the first (1:16) and second (1:256) blood serum sample. The patient recovered gradually. This is the first recorded human case of West Nile fever imported to the Czech Republic.


Applications of research results

Effects of forest clearing on the abundance of Ixodes ricinus ticks and the prevalence of Borrelia burgdorferi s.l.

Questing Ixodes ricinus ticks were collected on a forest trail that had been completely cleared of shrubs and ground vegetation in winter 2002 and on a nearby control uncleared forest transect in South Moravia (Czech Republic). Samples were collected each May in 2003, 2004 and 2005. Nymphal ticks were 3.4, 1.9 and 1.2 times less frequent on cleared forest than on uncleared trails in the three perspective years, whereas adult tick abundance was 27.2, 4.0 and
2.2 times lower, respectively. The ticks were examined for borreliae by dark-field microscopy: prevalence of nympha! ticks infected with *Borrelia burgdorferi sensu lato* (12.6% to 20.0%) did not differ significantly between the cleared and uncleared trail during the three years. In conclusion, the habitat modification appeared to result in a decreased abundance of *I. ricinus* as well as a reduced frequency of infected ticks (and thus indirectly a lower potential risk of Lyme borreliosis), which lasted, however, for only two years. Eight cultures of borreliae isolated from the ticks were all identified as the „ornithophilic” genomic species *Borrelia garinii*, possibly indicating a greater role of forest birds than that of forest rodents as the hosts of immature *I. ricinus* in the tick (and borreliial) colonization of the cleared part of the forest.


L. Ševčíková handling biological material in a hazard box. (Photo by I. Rudolf)
International cooperation

Prevalence of *Borrelia burgdorferi* sensu lato in the tick *Ixodes ricinus* in the Styrian Mountains of Austria

A total of 691 *Ixodes ricinus* ticks (22 males, 39 females, 501 nymphs and 129 larvae) were collected by flagging method from vegetation in 11 areas at altitudes between 789 and 1350 m above sea level in mixed woodland with pastureland and cattle in the province of Styria (Austria). They were examined for presence of *Borrelia burgdorferi* s.l. by dark field microscopy and PCR. Attempts to cultivate borreliae were made in BSK-H medium. The overall positivity rate of all collected ticks (excepting larvae) was 10.9%: 9.1% in males, 17.9% in females and 10.4% in nymphs. The larvae examined showed no presence of *B. burgdorferi* s.l. The mean infection rate of the vector of Lyme disease in the collection area of the highest altitude in this study - and the highest reported in Europe (Gaberl, 1350 m a.s.l.) was 6.4%: 1/9 males, 2/18 females, and 6/114 (5.3%) nymphs were positive. Culture attempts were positive in 12 cases and species identification showed eight isolates of *Borrelia afzelii* and four of *Borrelia garinii*. Three additional positive results found by PCR method (negative by dark field microscopy) were identified twice as *B. afzelii* and once as *B. garinii*. This study showed that the risk of acquiring of Lyme disease in habitats at higher altitudes is limited due to a lower density of *I. ricinus* and lesser infection rate of ticks than at lower altitudes in Central Europe, nevertheless it does exist.


I. Rudolf preparing samples for PCR procedure. (Photo by J. Halouzka)
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Mgr. Radka Poláková
Mgr. Marie Verkaeren
Mgr. Martina Vyskočilová
Mgr. Barbora Zemanová

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Hana Patzenhauerová
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Technicians
Mgr. Anna Bryjová
Dušan Havelka
Research priorities

The studies are performed on both laboratory and natural populations. Empirical data from observations and experiments supplemented by simulation modelling are used to investigate important questions of evolutionary biology, such as (model organisms given in parentheses):

- hybrid zones as barriers against gene flow and their role in speciation (*Mus, Sorex, Triturus*)
- study of factors affecting population structure (fish, bats and mammals)
- links between life history traits, adaptive genetic variation and population dynamics in small mammals (voles)
- phylogeography and reconstruction of historical colonization (*Mustela, Clethrionomys, Microtus*)
- analysis of reproductive success by using DNA markers (paternity analyses in fish, birds and mammals)
- conservation genetics of endangered vertebrate species (*Lutra, Rupicapra*); development of non-invasive techniques of DNA sampling
- mechanisms and evolution of thermal physiology traits in ectotherms (*Triturus*)
- functional approaches in studying morphological adaptations (*Zootoca, Triturus*)

The results of these investigations are used in preparing recommendations for nature conservation, rodent pest control, lecturing at universities in Brno, České Budějovice, Prague, and Olomouc.

Selected research results

**Behavioural and genetic study of speciation in a hybrid zone in the house mouse, *Mus musculus***

Two house mouse subspecies, *Mus m. musculus* and *M. m. domesticus*, form a long and narrow hybrid zone (HZ) running in Europe from Denmark to the Black Sea. Despite long-term interest in the study of this contact zone we have still a limited information about proximate mechanisms maintaining the HZ and thereby keeping the parental taxa in parapatry. To solve this question, we conducted a study of another part of the mouse HZ within the last 10 years. Based on maximum-likelihood analysis of more than 1500 mice from 105 localities we characterized the Czech-Bavarian transect across the HZ [1]. While most of molecular markers show similar transition in terms of frequencies from one taxon to another we found that one marker located on mitochondrial DNA is shifted from the centre and this shift is random when two transects are compared [2]. To determine factors keeping the two mouse
taxa apart and preventing intermixing of their genomes, we transported some mice to the laboratory and studied fitness components of parental and hybrid individuals. Behavioural studies focusing on assortative mating indicate that salivary signals (androgen-binding protein) most probably participate on subspecies specific recognition but in themselves are not efficient

(A) The course of the *musculus/domesticus* hybrid zone in Europe. Circles indicate previously studied transects in Denmark, Germany and Bulgaria. In the insert, the position of the Czech study area is indicated. (B) Location of 105 sampling sites. The thick dashed line is an approximate zone center defined as a 0.5-isocline derived from the bicubic spline smoothing of allele frequencies at each site.
enough to noticeably impede gene flow [3]. Hybrid male sterility is among presumed factors which can prevent gene flow between diverging subpopulations and in a pivot study we showed that genes causing spermatogenetic breakdown are polymorphic and widespread in wild *M. m. musculus* [4].


**Non-invasive genetic sampling**

Genetic studies of elusive or endangered species are often constrained by difficulties in obtaining sufficient number of samples. We optimised the method and increased the success rate of otter (*Lutra lutra*) faeces genotyping using microsatellite and SRY markers. The optimised method was used to estimate population size and structure of free-ranging otters in two different habitats without any contact or disturbance of animals. Complete reliable genotypes were obtained from 60% of samples. Together with tissues from otter carcasses (mostly road-kills), faecal samples were used to study genetic variability, structure and demographic history of otter populations in the Czech and Slovak Republics. Throughout analyses, strict recommendations to avoid contamination and genotyping errors were followed.

In another study, we successfully applied non-invasive approach on PCR-based test for species identification of two cryptic bats *Pipistrellus pipistrellus* and *P. pygmaeus*. DNA analysis of droppings obtained during trapping or other handling of individuals can substitute the punching of wing-membranes. The results can be potentially obtained even without contact with animals, e.g., using fresh droppings from day roosts.

Another valuable source of samples for molecular genetic studies is museum collections. We have been able to perform a comprehensive phylogeographic research of a stoat (*Mustela erminea*) using mitochondrial DNA sequences from DNA isolated from museum skin collections. We took particular care to ensure authenticity of sequences from the museum samples using methods derived from laboratory protocols for handling ancient DNA.


**KAŇUCH P., HÁJKOVÁ P., REHÁK Z., BRYJA J., in press: A rapid PCR-based test for species identification of two cryptic bats *Pipistrellus pipistrellus* and *P. pygmaeus* and its application on museum and dropping samples. Acta Chiropterologica.**

Applications of research results

Implementation of the Convention on Biological Diversity in the Czech Republic

In May of 1999 the UN Development Programme and the Global Environmental Facility announced a capacity development initiative that was intended to support effective implementation of international agreements adopted under the auspices of the United Nations, concerned with improving the state of the environment on the Earth. On the basis of this Initiative, a National Capacity Self-Assessment project was commenced to perform thorough analysis of conditions in implementing the three international agreements, adopted at the UN Global Conference on the Environment and Development, held in 1992 in Rio de Janeiro. The analysis is intended to lead to identification of capacity constraints for meeting the obligations of states following from these agreements and to the preparation of an action plan to improve the situation. Thus, this assessment is intended to evaluate the state of preparation of the Czech Republic for implementation of the objectives of the Convention on Biological Diversity. An evaluation is made of the level of strategic planning and proposal of individual steps and prospects, and problems are sought that can be identified as being critical from the standpoint of achieving the intermediate and final targets. In order to provide for the intentions formulated in the Convention, it is above all necessary to create and develop suitable capacities at the individual, institutional and systemic levels. This approach is fundamentally promoted in the assessment.


Threatened mammal species, Eurasian otter Lutra lutra, can be studied using non-invasive genetic methods (Photo by J. Roleček).
The first gorilla born in the Czech Republic is a girl

The first offspring of the western lowland gorilla in the Czech Republic was born at the Prague ZOO in December 2004. This birth received great publicity and has been popularized in various TV and radio-broadcasting programmes. However, the gender of the young remained enigmatic. Two independent laboratories performed genetic studies aimed to sex identification of the individual but their results appeared contradictory.

The Institute was then asked by the authorities of the Prague ZOO to make additional investigations. The suitability of the genetic sex identification was tested by using blood samples of adult gorillas of known sex. Duplex PCR was conducted to amplify parts of the Sry gene (occurring only in males), whereas the Zfy-Zfx gene (amplified in both sexes) was used as a positive control of a PCR reaction. Then we used fresh samples of faeces for DNA extraction and amplification in the young and its father. The results showed unequivocally that the young named Moja is a female.

International cooperation

Historical and contemporary selection on major histocompatibility complex genes in cyclic rodents

Host-pathogen interactions are of particular interest in the understanding of the interplay between population dynamics and natural selection. The genes of major histocompatibility complex (MHC) of demographically fluctuating species are very suitable markers for this purpose because they are involved in the initiation of the immune response against pathogens.
and they exhibit high levels of genetic variation that are proposed to be adaptive in natural vertebrate populations. We optimised single strand conformation polymorphism analysis method using capillary electrophoresis to study polymorphism of DNA sequences in large scale population studies [1] and applied this method to analyse the variation of two MHC Class II genes (DQA1, DRB) during the demographic cycle of the water vole *Arvicolus terrestris*. Positive historical selection was found to act very intensively on antigen-binding sites of MHC molecules in arvicolid rodents as documented by extensive trans-species polymorphism within the subfamily. For the first time within rodents, we documented the duplication of the DQA gene in three vole species with both copies being transcriptionally active [2]. We compared neutral genetic structure of seven populations (estimated from 14 microsatellites) with that estimated from MHC genes and we evidenced more intense selection on the gene DQA1 than on DRB or neutral markers and this pattern emphasized with increasing population abundance. In the year of low abundance, when populations were geographically isolated, overall differentiation patterns of both MHC genes were more pronounced than at neutral markers suggesting the action of local selection in fragmented populations. With increasing effective migration between sites the differences between MHC and neutral markers progressively vanished and in the high-abundance year, overall differentiation for DQA1 gene became even significantly lower than those of neutral markers, suggesting more homogenisation for that gene than what could be observed by chance for a neutral gene evolving under drift and migration only. Spatial and temporal fluctuations in parasite pressure are proposed as the most plausible mechanism inducing observed changes in contemporary selection pattern during demographic cycle [3].


**Evolution of form and function in newts**

Conflicts between structural requirements for carrying out different ecologically relevant functions may result in a compromise phenotype that maximizes neither function. Identifying and evaluating functional trade-offs may therefore aid in understanding the evolution of organismal performance. We examined the possibility of an evolutionary trade-off between aquatic and terrestrial locomotion in females of European species of the newt genus *Triturus*. Biomechanical models suggest a conflict between the requirements for aquatic and terrestrial locomotion. For instance, having an elongate, slender body, a large tail and reduced limbs should benefit undulatory swimming, but at the cost of reduced running capacity. To test the prediction of an evolutionary trade-off between swimming and running capacity, we investigated relationships between size-corrected morphology and maximum locomotor performance in females of ten species of newts. Phylogenetic comparative analyses revealed that an evolutionary trend of body elongation (increasing axilla-groin distance) is associated with a reduction in head width and forelimb length. Body elongation resulted in reduced maximum running speed, but, surprisingly, also led to a reduction in swimming speed. The
evolution of longer tails was associated with an increase in maximal swimming speed. We found no evidence for an evolutionary trade-off between aquatic and terrestrial locomotor performance, probably because of the unexpected negative effect of body elongation on swimming speed. We conclude that the idea of a design conflict between aquatic and terrestrial locomotion, mediated through antagonistic effects of body elongation, does not apply to our model system.


![Diagram of Triturus newts showing body elongation and limb reduction within the *Triturus cristatus* group](image)

Species of the *Triturus cristatus* group showing the most prominent trend in body elongation and limb reduction within the (*Triturus*) clade.
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Research Priorities

The research of fishes is performed at various levels of spatial and biological organization (individual, population, and community), in relation to distribution, biology, ecology, and diversity. The study reflects the heterogeneity of aquatic environment, both in term of habitats and microhabitats, and the biodiversity between and within species. Fishes are considered to be complex bioindicators of degradation as well as regeneration of aquatic habitats. Accordingly, a number of activities are aimed at restoring and revitalisation of aquatic ecosystems.

Main research topics:
- diversity of fish communities and population parameters of key species in various types of aquatic habitats
- genetic diversity of fish populations
- rehabilitation of aquatic habitats and ecosystems for the restoration and conservation of fish biodiversity
- biology and conservation management of threatened species
- alien invasive species and their impact on native fish biodiversity
Selected research results

Growth characteristics of the barbel, *Barbus barbus*, in the middle course of the Jihlava River

Growth in length and weight, based on a combination of scale annulus interpretation and back-calculation using the Fraser-Lee model, was studied in male and female barbel, *Barbus barbus*, from a section of the Jihlava River sampled in 1999–2001. Results were compared with growth data obtained with similar methods in 1976, prior to construction and functioning of a hydropower scheme complex (Dukovany-Dalešice), and during the period of the scheme’s partial operation (1980–1984). Recent growth rate, under seemingly fully-established environmental conditions and complete adaptation of the barbel population, showed the highest values, especially in males. A distinct sexual dimorphism in growth rate was also confirmed, with females growing faster than males, though to a lower extent than recorded both during previous periods and from several other localities. Further, upon comparison of back-calculated lengths for previous years of recently tagged-and-recaptured fish (1999–2001), with observed lengths directly measured at corresponding ages, no significant differences were overall found between the results obtained by either method in most age groups. Finally, the linear Fraser-Lee model proved a sufficiently accurate and practical method for back-calculating lengths for previous years of life also in barbel.

Physiological and behavioural differences between *Carassius auratus* lineages differing in ploidy levels and parental origin

In recent years, original uniform (unisexual-triploid) populations of silver crucian carp in central Europe transform dramatically. Previous state of sporadic diploid individuals’ occurrence (both males and females) has been gradually substituted by current state, where on some localities these diploids begin to dominate. Main goal of our experiments is to understand factors which affect this dynamics of diploid-polyploid complexes.

The reactions of the individuals *Carassius auratus* on temperature and low-oxygen stress were observed. The results show differences in dependence not only on the ploidy levels but also on their ancestry. It may be an important selective factor in specific natural conditions which affected occurrence this groups in specific biotope. Haematological analysis was performed on 27 adult specimens of *Carassius auratus* irrespective of sex in 2003 and on 32 juveniles of distinguished sex in 2004. In this study we found that the ploidy level affected significantly ($p < 0.01$) the values of the erythrocyte count, mean corpuscular volume and mean corpuscular haemoglobin. Although we did not prove any significant effect of sex in juvenile diploids of *C. auratus* on the values of erythrocyte profile, the erythrocyte count, haematocrit value and haemoglobin content value were higher for males than for females. The erythrocyte count decreased significantly ($p < 0.01$) with increasing ploidy level. The index of haemoglobin content followed the same trend of a decreasing mean value with increasing ploidy level. Mean corpuscular volume and mean corpuscular haemoglobin increased with the increasing ploidy level ($p < 0.01$). Haematocrit value and mean corpuscular haemoglobin concentration did not significantly differ from the point of view of the ploidy level.

Different depth preferences for swimming of diploid (left) and triploid (right) *Carassius auratus* in an aquarium. (Photo by K. Hałačka)

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The nematode parasites of vertebrates: a potential sentinel species of heavy metal accumulation

To assess the bioindicator value of parasites, the concentrations of six heavy metals (Cr, Cu, Pb, Cd, Ni, and Zn) were analyzed by atomic absorption spectrometry in pregnant females of the nematode *Philometra ovata*, body cavity parasites of gudgeon (*Gobio gobio*) and muscle samples of infected and uninfected hosts. The concentration of heavy metals was significantly higher in specimens of *P. ovata* compared to the host muscle tissue.

The parasite-to-muscle ratio of heavy metals varied from 3.2 to 121.7, in increasing concentrations for Cr, Cd, Cu, Pb, Ni and Zn. The presence of parasites did not influence the heavy metal content of the hosts, and no significant differences were found between muscle tissues of parasitized and non-parasitized fishes. The bioconcentration factor (BFs = C_parasite / C_sediment) varied between 0.4 and 25.8 and BFw (C_parasite / C_water) between 2133 and 25354. In conclusion the *P. ovata* – gudgeon parasite host system is an effective and practical bioindicator, even a sentinel system, of heavy metals load in aquatic ecosystems. Our results demonstrate that this parasite accumulates heavy metals at higher rates than the other nematode species (*Anguillicola crassus, Contracaecum rudolphii, Protospirura muricola*).

BARUŠ V., TENORA F., ŠUMBERA R., 2003: Relative concentrations of four heavy metals in the parasites Protospirobranchus muricola (Nematoda) and Inermicapsifer arvicantidis (Cestoda) in their definitive host silvery mole-rat (Helophobius argentocinereus: Rodentia). Helminthologia 40: 227–232.


Vimba vimba: a locally vanished and endangered species

In the past, Vimba vimba was among the key components of the fish assemblages inhabiting the middle and lower reaches of streams in the Czech Republic. Dam building, water pollution, fragmentation of the longitudinal continuum of most rivers in the course of the 20th century has resulted in the fact that at present the species is classified as Vulnerable. The degree of its threatening differs in various drainage areas. The species is comparatively abundant in some parts of the Labe and Vltava drainage area (the Berounka River, the lower reaches of the Labe River, the confluence of the Malše and Vltava rivers). Recently, V. vimba has vanished from the drainage area of the Odra River. In the Morava drainage area, it is rather numerous in the middle and lower reaches of the Bečva River. Residual populations exist in the Dyje River upstream of the Vranov Reservoir and in the lower reaches of the Jihlava River.

Investigations on the remnant Vimba population in the Dyje River upstream of the Vranov Reservoir, carried out in 1934, have shown that it can survive for 70 years at a low level of its genetic diversity. The numbers of the adult component of this population does not exceed one thousand individuals. In view of the low mean age of the population, with just two age groups being responsible for reproduction, it has been recommended to foster the population with material obtained by hand-stripping and rearing individuals from that population.

Besides, another important measure to improve the status of Vimba vimba populations could inhere in successively renewing the migration permeability of streams in their longitudinal profile. Like Chondrostoma nasus, Vimba vimba is among the fish species that perform long-range spawning migrations.

The concentration of heavy metals in a specimen of P. ovata and the host Gobio gobio muscle tissue.
Characteristics of populations of the *Zingel zingel* and *Zingel streber* in the Czech Republic

*Zingel zingel* and *Zingel streber* are typical Danubian species occurring rarely in the Morava River drainage area within the Czech Republic. Due to weir constructions and especially due to increase of water pollution during the first half of the last century, they disappeared from our waters, and both species were assessed as critically endangered and protected by the national and European legislations. Only after improvements of the water quality in the Morava and Dyje Rivers, the new occurrence of *Z. zingel* was ascertained as early as in 1992, and that of *Z. streber* in 2003 in the area of the confluence of both rivers. A very numerous occurrence of young-of-the-year *Z. streber* specimens evidenced a successful reproduction.

The restoration of both species was enabled by constant improvements of the water quality and by possibilities of free migrations from the Danube through the Slovakian-Austrian part of the Morava River. The stable occurrence of both species is constrained at present to short sections (Morava r.km 70–74.1 and Dyje 0.0–26.7).

The karyotype of *Z. zingel* was analyzed. The diploid chromosome number was 2n=48 for the female, and only 2n=47 for the male, but there was also present a single large unpaired metacentric chromosome. This indicated the presence of the X1X1X2X2/X1X2Y multiple sex chromosome system produced by the fusion of two sub- or acrocentrics chromosomes, one of them being the sex chromosome Y.
Applications of Research Results

Removing of migratory barriers fragmenting large rivers

A weir in Břeclav, river km 27, constitutes the first migratory barrier for water fauna on the lower Dyje River, which has free migratory route to the Danube River through 70 km long
Slovakian-Austrian stretch of the Morava River. At the end of 2005, a new fishpass was put into service within the frame of „Action plan of floodpass building on selected rivers of the Czech Republic“. During 2006, we conducted a monitoring of its function performance. It was stated that both the entrance and interior bouldered migratory parts are fully functional for whole species and age spectrum of fish community. From the aspect of fish migration it is necessary to optimize the upper part including the exit part of the fishpass. Feasible modifications (such as enlargement of entry slots and adding of 2–3 rows of boulders in upper parts) should allow full migratory passability for the whole species range of the lower Dyje River ichthyofauna.

Floodgate Střekov constitutes the first migratory barrier on the Elbe River (river km 321) on the territory of the Czech Republic. In 2001, the new lowland pool fishpass was built there in connection with the project „Salmon 2000“, allowing periodical monitoring of migrating fishes. Significant numbers of juvenile (age 0+) and subadult (age 1+ and 2+) fish were observed migrating through a lowland pool fishpass from August to October in 2003 and 2004. Records of weekly catches totalled 2 148 (2003) and 6 469 (2004), mainly bleak, barbel, roach and dace. Fish migrated in the upstream direction probably to search the feeding grounds and refuges and their numbers corresponded to spring spawning migrations in the same fishpass and the year.

Artificial wetlands – significant support for stable fish biodiversity in a river alluvium

The natural dynamics of water discharges and the ensuing fluvial stream activity resulted in a considerable diversification of aquatic environments in fluvial ecosystems. Besides the active streams in flooding area, there originated and developed a diversified system of aquatic habitats. This hydrological system offered conditions for fish assemblages showing a high species richness. However, the modifications of most streams as well as other human activities resulted in a limitation or complete elimination of any fluvial activity of the streams. Therefore, new habitats are no longer created by the natural activity of water discharges and fluvial activity. On the contrary, the habitats created by the streams in the past are now gradually vanishing.

Now there are two alternatives as regards the future of these habitats: either the existing natural habitats can be maintained and renewed by human efforts, or new habitats can be provided in the form of artificial wetlands (earth pits, channels, artificial pools and lakes). Alluvial habitats are irreplaceable environments for several indigenous fish species protected by native as well as European legislation: *Rhodeus amarus*, *Misgurnus fossilis*, *Cobitis elongatoides* incl. hybrid populations, *Umbra krameri* and, of other species, *Carassius carassius*, *Tinca tinca* and *Leucaspius delineatus*. Also, artificial wetlands can provide more stable environments for the survival of fishes during critical periods. Artificial habitats, connected with the main stream or flooded during floods are populated by species inhabiting the major stream. The artificial aquatic habitats lying outside the active alluvium can be provided with fish assemblages aimed at conservation goals. The highly positive contribution of artificial habitats in stabilizing populations of the species mentioned above has been demonstrated in concrete objects in the floodplains of the rivers Morava, Dyje, Lužnice and, in eastern Slovakia, the drainage areas of the Bodrog, Latorica, Tisza and Ondava rivers.


Two time stages of the artificial wetland in the Chomoutov Nature Reserve. (Photo by S. Lusk)
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Field laboratory in the town of Vidin, Bulgaria. Left to right: M. Vassilev, T. Trichkova, M. Ondračková, M. Polačík, K. Francová, M. Dušková. (Photo by J. Huml)
Research Priorities

We use fish to investigate questions in ecology and evolution as well as applied issues in fisheries management, conservation of aquatic habitats and floodplain restoration. Our field and experimental studies are conducted in Europe, Asia and Africa. The current topics investigated in our department are:

- behavioural and evolutionary ecology of bitterling fish
- adaptation and coevolution of bitterling and their mussel hosts
- ecology, distribution and parasites of invasive Neogobius fishes
- 0+ juvenile fish community structure in lowland rivers and their flood plains
- optimisation of methods for 0+ juvenile fish sampling
- impacts of metazoan parasites on 0+ juvenile fish development
- community ecology of fishes in the Gambia River floodplain, Senegal, West Africa
- reproductive isolating mechanisms in the East African annual fishes Nothobranchius spp.

Selected Research Results

The coevolutionary relationship between bitterling fishes and freshwater mussels

Bitterlings (subfamily Acheilognathinae) are freshwater cyprinid fishes that have evolved an unusual spawning symbiosis with freshwater mussels from the family Unionidae. Female bitterling develop long ovipositors that they use to place their eggs deep inside the gill cavity of a mussel and males fertilise the eggs by releasing sperm into the inhalant siphon of the mussel. Bitterling embryos develop inside the mussel gill cavity for weeks and constrain mussel physiology. In turn, unionid mussels have parasitic larvae called glochidia. They are released into the water column, attach to fish gills or fins and obtain nourishment from the fish host. We found that relationship between bitterling and mussel, popularly considered mutualistic on the premise that bitterling use mussels as spawning sites while the mussel benefits by using bitterling to disperse their glochidia, is more complex.

We investigated the costs and benefits from the symbiosis to both fish and mussels and found that in Europe, bitterling are parasites of mussels. European bitterling do not host glochidia, but adult European mussels suffer from a reduction in growth and fecundity if they carry bitterling embryos. In a further study, we found that this may be due to a lag in the coevolutionary relationship – bitterling presence in Europe is recent and mussels may have not had enough time to evolve sufficient adaptations. Indeed, in Asia, where bitterling origin is ancient, mussels are able to eject bitterling eggs and embryos prematurely, similarly to the eviction of cuckoo eggs by their bird foster parents. In a large scale comparative study in China, we discovered that the bitterling species vary in the level of their specificity to particular hosts and revealed a complex network of relationships between bitterling and mussel traits.

Sexual selection in the bitterling fish: the role of female choice and male mating tactics

Natural selection theory is based on the principle of unequal individual reproductive success within a species. This is caused by differential survival among individuals (ecological adaptations) and different number of offspring produced by individuals (sexual selection). Sexual selection explains the evolution of adaptations to maximise the individual reproductive potential, particularly adaptations to male-male interference competition for females and female choice. Using a series of experiments with a small cyprinid fish, the European bitterling, *Rhodeus sericeus*, we separated the two components of sexual selection and investigated their relative importance by estimating male reproductive success through paternity assignments. For individual males, the success in male-male competition for territories was significantly...
more important than female preference of a given male. Dominant males monopolised access to territories and sired considerably more offspring than males preferred by females. Therefore, the hierarchical rank of males reduced opportunities for female choice and females, despite being choosy, had limited control over the paternity of their offspring. In another set of experiments, we found that female bitterling may use sophisticated behaviour to prolong the spawning act and solicit sneaking fertilisations from subordinate males. This behaviour enables preferred, but subordinate, males to sire some offspring. Our data suggest new prospect in explaining the evolution of alternative male reproductive tactics, so far considered as a “parasitic” strategy undermining female choice.

Our results show that alternative male tactics may, contrary to the current view, augment rather than decrease the role of female choice. Given the important consequences of this finding on effective population size, our results have also general implications in the management of natural populations.

Sampling methodology and monitoring of 0+ juvenile fish in channelized lowland rivers

Fish reproduction and use of nursery habitats by 0+ fish have been long-term monitored (1991-2006) in lowland channelized and regulated river Morava (r km 69.4–92.8). At twenty localities within the river stretch, 0+ juvenile fish assemblages are sampled in late summer by point abundance sampling (PAS) electrofishing.

PAS is widely used sampling strategy based on collecting numerous small (point) samples of the same size. This principle is considered to be more statistically robust than sampling low number of large samples. To evaluate its suitability for monitoring 0+ juvenile fish assemblages, we compared PAS with a strategy that surveys the given area in its whole length: a continuous sampling. Both strategies provided similar estimates of 0+ juvenile fish assemblages, in terms of species richness, species composition, relative proportion of the most abundant species and size structure. PAS proved to be the less time-demanding strategy (consuming approximately 60% of time compared to CS) allowing either surveying the fixed area quicker than CS or surveying longer area within fixed time interval. We therefore evaluated PAS as an appropriate strategy for sampling 0+ juvenile fish in lowland channelized rivers.

Though the lower part of the Morava River was modified for navigation, it is currently not used for this purpose. Therefore a variable water discharge is allowed to occur, which creates more habitat variability. The riprap bank is a uniform bank type occurring along the shoreline. Gently sloped sand-gravel beaches are formed along the inner bands of the river during low summer discharges. During periods of elevated discharge, the water level reaches the bank-side vegetation above the boulder bank. All these habitat types are, according to our results, suitable for, and to a large extent utilized by, the 0+ juvenile fish assemblage.

Mainly bitterling, chub, bleak, and gudgeon have adapted to the conditions following river modification and form abundant and stable populations. These species reproduce successfully and form a major part of the 0+ fish community. Specialist species (phytophils and most of lithophils) are disadvantaged, in term of their reproductive success.


Applications of Research Results

Water Framework Directive implementation

Since 1999, we have provided monitoring of young-of-the-year fishes in selected profiles of the river network that were included in the water quality assessment program in the Czech Republic (coordinated by Water Research Institute TGM Praha). In 2005, National Methodology for fish monitoring program within WFD implementation, based on international sources (FAME, CEN), has been completed and tested. During 2006, this methodology has been used in monitoring of 174 sites. The monitoring of young-of-the-year fish has been proven as a suitable methodology for WFD evaluation in the intensively stocked rivers in the Czech Republic.

International Cooperation

Distribution, ecology and parasite fauna of zebrafish (Danio rerio) in Bangladesh

Zebrafish, Danio rerio, is a well established laboratory species in biomedical research. It has proven to be hugely influential in studies on gene expression of physiological, morphological and behavioural traits. There are surprisingly few data available on zebrafish natural behaviour and ecology. We have participated in an expedition that collected data on geographical distribution, habitat preferences, population structure and parasite load of wild zebrafish in Bangladesh. We found that zebrafish inhabits standing water bodies within the floodplain rather than river environment and that it is the most abundant in shallow lakes, ponds and ditches with rich vegetation at the margins. It is commonly abundant in water bodies with a connection to rice cultivation. We have identified parasite fauna of zebrafish based on a dissection of 120 individual zebrafish and eight additional fish species co-occurring with zebrafish. Our results suggest that there are large differences in parasite abundance and species richness among zebrafish populations from across Bangladesh which may be used in subsequent studies linking genetic background and susceptibility to parasitic diseases.

This project is based on the international cooperation with University of Leicester (United Kingdom), University of Khulna and University of Mymensingh (Bangladesh).


Distribution, ecology and parasites of Neogobius fishes in their native and non-native area of distribution

Four Ponto–Caspian gobies of the genus Neogobius are regarded as invasive species because of their ability to rapidly establish abundant populations in the non–native areas, as was
documented in Europe and North America. In the non-native range, *Neogobius* spp. may affect local ecosystem directly e.g. by changing food web interactions, or indirectly by acting as a vector for non-native parasites. To explain the successful introductions of *Neogobius* spp. in the Danube River basin, we investigated their distribution, ecology and parasites in both native and non-native range (lower and middle Danube, respectively). We found that *N. melanostomus* and *N. kessleri* dominated in the non-native range whereas *N. fluviatilis* dominated in the native range. Our results of fish distribution support the hypothesis of disjunctive spreading since very low population densities of *N. gymnotrachelus* and especially *N. melanostomus* were registered in the Croatian section of Danube, i.e. in the middle between native and non-native abundant populations. *N. gymnotrachelus* was relatively rare in both examined Danube stretches. *N. kessleri* and *N. melanostomus* reached a bigger size in the non-native area and some differences between populations were found also in the diet.

Parasite fauna of native and non-native populations of *N. kessleri* and *N. melanostomus* showed slight differences in both parasite abundance and parasite species richness. Parasite community in riverine fish did not differ among populations especially in *N. kessleri*; on the other hand, in fish from side-arm system, a habitat untypical for this fish species, the parasite species richness was two times higher than in the river. Parasite fauna of *Neogobius* spp. comprises mainly common and abundant parasites in the particular site showing very low host specificity. Ponto-Caspian gobies seem to be fish hosts very susceptible to various parasite species and their parasite community reflects the fish feeding strategy and habitat preference.

This project is based on the international cooperation with Bulgarian Academy of Sciences (Bulgaria), University of Osijek (Croatia) and University of Vienna (Austria).


Racer goby *Neogobius gymnorachetus*. (Photo by P. Jurajda)
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Research priorities

Our research focuses on understanding the ecological and evolutionary basis of reproductive
strategies. Important goals of this research are to identify the ecological factors that promote
parasitic reproductive behaviour, predator avoidance and nest predation. We conduct studies
adopting the adaptationist and optimality approach of behavioural ecology to examine fitness
costs and benefits of various characters in bird populations. Further we aim at understanding
the evolution and signalling function of secondary male ornaments in birds. Using genetic
markers we study population differentiation and phylogeography of selected European
passerines across migratory divides which are inferred from measurements of stable isotope
ratios and ringing recoveries. Our current research also concentrates on patterns of singing
activity in passerines and includes studies of parasites associated with birds of the Afrotropical
and Neotropical Regions as well.

Selected research results

Extra-pair fertilizations and mechanisms of mate choice

Extra-pair fertilizations (EPF) are frequently documented in songbirds. A costs–benefits
approach has frequently been used to understand the evolutionary origin and maintenance
of promiscuity in this group. Recent meta-analyses suggest that direct costs to unfaithful
females outweigh indirect benefits from infidelity in socially monogamous songbirds, what
indicates that in these taxa, EPF evolved primarily as a self-interest male tactic. We performed a comparative analysis to show that standardized selection gradients acting against female infidelity (direct costs of promiscuity) explain variation in EPF rates at an interspecific level in passerines. This result confirms that costs to females resulting from reduced parental care by cheated males constrain promiscuity in this group. Our data indicate that females exert resistance over EPF when the costs of infidelity are high and, conversely, that the rate of EPF increases when selection on females to defend themselves against EPF attempts by males is weak and costs of infidelity are low. Indirect (genetic) benefits to females should play a central role in choice of extra-pair mate, since female birds do apparently obtain only sperm from these mates. There are two basic models of mate choice in animals, with indicator model proposing an absolute criterion of mate choice such as sexual ornaments, and the other one proposing (dis)similarity between the female and male as the main mechanism. The latter is often called choice of ‘genetic compatibility’ in recent literature. However, the term ‘genetic compatibility’ has an existing meaning in speciation and we therefore propose use of the term ‘genetic complementarity’ over ‘genetic compatibility’. This is in agreement with Trivers (1972) who was to our knowledge the first to clearly articulate the phenomenon of mating based on genetic dissimilarity.


Coevolution between European hosts and their brood parasites

Successive adaptations and counteradaptations by avian brood parasites and their hosts provide some of the best examples of direct coevolution in nature. Successfully parasitized hosts often raise only the cuckoo young and have zero reproductive success. This creates conditions for coevolutionary arms race between hosts and parasites. We studied both adaptations of the hosts and counteradaptations of the parasites, respectively.

We tested experimentally responses of the hosts towards multiple cuckoo parasitism and suggest that when the parasitism rate reaches high levels, e.g. at the beginning of the coevolutionary arms race, defense against multiple parasitism may be an important component of host’s adaptation to brood parasitism in general. Other major adaptations are those related to the parasitic egg. We evaluated the puncture resistance hypothesis for the occurrence of thick-shelled eggs in common cuckoo by investigating costs of cuckoo egg ejection in four Acrocephalus warblers. Last but not least, we tested great reed warbler discrimination against two cuckoo morphs in two areas with different parasitism rates and proportions of the two morphs. Our results suggest that both local parasitism pressure and relative abundance of the two colour morphs of a brood parasite may significantly influence host defences. Finally, we studied laying strategy of cuckoo that is well-synchronized with that of the host. This matching of laying patterns with those of the hosts suggests an adaptive response to ensure optimal hatchability of the cuckoo eggs and to avoid multiple parasitism of the same nest even under heavy pressures of brood parasitism.

Savi’s warbler: A model species for studying the patterns of singing activity

Males of many bird species spend enormous amounts of time singing, which may amount to several hundred thousand songs per season. They sing in order to acquire a mate and to defend a territory and its resources or to minimize the risk of cuckoldry by neighbouring males and to maximize the probability of their own successful extrapair copulations. Diel patterns of singing vary among bird species in aspects such as the timing of peaks through the day or night and throughout the season.

We studied seasonal and diel patterns of singing activity of Savi’s warblers *Locustella luscinioides* in two areas of Central Europe 300 km apart, over a period of 18 years. We assess about 4,600 records of individuals singing. Males were found to exhibit similar singing activity in both study sites. They started to sing after arrival at the beginning of April and peaked from the end of April to the beginning of May. Thereafter, their singing activity was lower but more
stable for a relatively long period from mid-May to mid-July. At the end of July, males sang only sporadically and singing activity ceased at the beginning of August. At the beginning and towards the end of the song-period males sang sporadically whereas in the period of the highest singing activity they sang over the entire 24-h period. During the whole song-period, there was a significant difference in singing activity between daylight and the dark (67.2 and 32.8%, respectively). However, the period of daylight was longer. Average singing activity showed similar levels in daylight and the dark with mean numbers of 5.9 and 6.6 males per hour, respectively. Major changes in singing activity were related to the twilight periods. There were distinctive dawn and dusk choruses. In the morning, Savi’s warblers exhibited similar levels of singing activity over 3 h of the dark before twilight, singing reached its highest level at twilight and 1 h after twilight. During the evening, singing activity reached its highest level 1 h before twilight, while during twilight it was decreasing, with a considerable decline 1 h after nightfall.


**International cooperation**

**Coevolution between an African brood parasite and its hosts**

The red-chested cuckoo parasitizes many passerines in Africa, but some common species sympatric with the brood parasite are rarely used as hosts. Since very little is known about
brood parasitism on this continent, we experimentally tested responses of three turdid hosts to parasitism with artificial cuckoo egg. Our results support the hypothesis that rejection behaviour in two species (olive thrush, Kurrichane thrush) evolved as defence against interspecific parasitism, with thrushes appearing to be ahead in the host–parasite arms-race. The Cape robin, by contrast, appears not to reject cuckoo eggs, either because it is unable to recognize them, or because the cost associated with removal may be too high.

This study was made in collaboration with the University of Stellenbosch (Matieland, South Africa) and it was supported by a John Ellerman Fellowship.


Parasites associated with birds native to rainforests on the Caribbean slope of Costa Rica

We undertook our research of ectoparasites on birds of the Cordillera de Talamanca mountain range in Limón province, southeastern Costa Rica. In the rainy season of 2004 (August through September), we sequentially studied birds at two locations (Hitoy Cerere Biological Reserve and Barbilla National Park) on the Caribbean slope differing in elevation and habitat character. A total of 530 individuals of 79 bird species were examined. In this contribution we focus on chewing lice (Phthiraptera) and mites (Acari: Macronyssidae) associated with hummingbirds (Trochilidae), typical antbirds (Thamnophilidae), ground antbirds (Formicariidae), manakins (Pipridae) and grosbeaks (Cardinalidae) inhabiting lowland tropical rainforests.

M. Čapek examining a long-tailed hermit Phaethornis superciliosus in the laboratory of Hitoy Cerere Biological Reserve, Costa Rica, August 19, 2004. (Photo by M. Havlíček)
We found five chewing lice species belonging to the genera *Formicaphagus*, *Machaerilaemus* and *Myrsidea* of which three are the species new to science. They and their type hosts are as follows: *Formicaphagus tyrannina* ex *Cercomacra tyrannina* (Thamnophilidae), *Myrsidea mcleannani* ex *Phaenostictus mcleannani* (Thamnophilidae) and *Myrsidea klimesi* ex *Formicarius analis* (Formicariidae). These are the first records of *Myrsidea* from members of the passerine families Thamnophilidae and Formicariidae. Mites were represented by three species of the genus *Pellonyssus* of which *P. cyanoides* from *Cyanocopsa cyanoides* is the species new to science.

Scientists from the University of Veterinary and Pharmaceutical Sciences in Brno, the Institute of Vertebrate Biology AS CR in Brno, the Institute of Parasitology AS CR in České Budějovice (Czech Republic) and the University of Queensland in Brisbane (Australia) collaborated on the work. We are grateful to the Ministerio del Ambiente y Energía de Costa Rica for permission to conduct our study.

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Research priorities
Research is focused on the ecology of selected mammalian groups. The results of investigations are aimed to improve management of forest stands, game management, rodent pest control, and protection of biodiversity.
Main research topics:
• feeding ecology of large herbivores and their impact on vegetation
• foraging ecology and anti-predator strategies of bats
• ecology and behaviour of large carnivores, and foraging ecology and distribution of mustelids
• synecology of small terrestrial mammals
• diversity and ecology of small mammals and ungulates of West Africa

Selected research results

Structure and diversity of small mammal communities in agriculture landscape

Result of six year trappings (51,480 trap/nights, total catch 5,536 small terrestrial mammals) in various field crops and other habitats in a poorly wooded agricultural landscape of southern Moravia (Czech Republic) were presented. Fourteen small mammal species were captured; the relative population density and dominance of each species in each crop and other habitats were evaluated. According to Renkonen’s index of similarity small mammal communities could be divided into two main groups: the first comprised windbreaks, small woods and fallow land with high dominance of species with affinity to forest environment; the other group is formed by open habitat communities. These were again divided into two groups: perennial crop group (as alfalfa) and one-year crop group (as corn, sugar beet, maize, and other crops). In the first group with forest affinity a higher diversity of small mammal community compared to second, open habitat one has been found. Changes of diversity index values according to the agrotechnical changes were also evaluated.


Relative abundance and community structure in spring+summer (S) and autumn+winter (W) samples in habitats studied. Cgla – Clethrionomys glareolus, Marv – Microtus arvalis, Mmus – Mus musculus, Asyl – Apodemus sylvaticus, Amic – A. microps, Afa – A. flavicollis.
Density and distribution of deer in a floodplain forest

Data on the density and distribution of deer help to protect artificial plantations and naturally regenerating stands against browsing damage, to select suitable additional feeding places and to assist in rational game management. Habitat selection by deer is best viewed as a trade-off between selection of cover and selection of food. High primary production, high biodiversity of the floodplain forest ecosystem and agricultural fields situated along the forest offer very specific conditions, which can significantly influence habitat selection of deer species living there. We analysed density and distribution of red deer and roe deer in relation to habitat structure and distribution of food sources during winters 2001–2004 in a floodplain forest along the Morava River. Densities of both species were relatively high (red and roe deer, 9.6 and 7.0 ind./km$^2$ respectively). Red deer preferred forest stands with dense cover (60–80 %) and a diversified shrub layer (more than three tree species). Roe deer mainly used old stands of age 50–99 years with a high cover of canopy layer and conversely low cover of herb layer, dominated by bramble. A positive relationship between the distributions of both species was detected. Inter-specific spatial interference was not observed, despite their high densities in the study area.


**Flight activity of bats during non-hibernation period**

We studied the flight activity of bats under three different conditions: a) emergence and return activity of bats in maternity colonies [1], b) foraging activity of bats [2 and 3], and c) flight activity in the entrance of natural karstic cave [4].

Parameters of return activity generally occurred at lower light intensities than those of emergence at six maternity colonies of pipistrelle bats (*Pipistrellus pipistrellus* and *P. pygmaeus*) in NE Scotland. Therefore, the interval between dawn return and sunrise was generally longer.
than that between sunset and dusk emergence. Emergence and return were equal in duration. Bats clustered more on emergence in comparison with return during pregnancy and lactation, whereas during postlactation this trend was reversed [1].

The foraging activity of bats was studied in karstic area and various natural forests. Bat detectors were used to record echolocation calls of bats on line transects during the first half of the night. *Myotis daubentonii* was the most numerous species. The number of bat species was the highest in rocky habitats, and the lowest in agrocoenoses. The greatest intensity of flight activity of the bat community was observed over ponds and streams [2]. Generally, the level of flight activity of bats detected in lowland forests was significantly higher compared to the activity in mountain forests. The highest activity was recorded in the floodplain forest. On the contrary, the mountain spruce forest was utilized by bats only scarcely. In lowland forests, the highest activity was registered in the pregnancy period and it gradually decreased towards the end of the season. In mountain forests, the level of activity was rather well-balanced throughout the season. In spite of that the lowest activity was obtained in pregnancy period. In all forest habitats, the flight activity was higher at the beginning of the night than before midnight [3].

Activity patterns of bats were recorded automatically with a double infrared light barrier at the entrance of Kateřinská cave (Czech Republic) too. Five periods were defined on the basis of bat flight activity. All periods showed a non-random temporal distribution and a concentration of flight activity around specific time. There was a positive correlation between the number of bat passes through the entrance and outside ambient temperature and a negative correlation between the number of passes and barometric pressure. Rain had no significant effect on the level of bat activity [4].

Křivé Lake (floodplain forest) where the highest bat flight activity was recorded. (Photo by Z. Řehák)
Applications of Research Results

Evaluation of game damage to the field crops

Field crops are extensively damaged by large herbivores in many localities of the Czech Republic. To judge the impact of herbivores on the yield of crop, plants at an early stage of development were experimentally clipped to simulate browsing varying in intensity. In some fields we evaluated the extent and economic effect of wild herbivore damage on main field crops. We also analysed and developed a new method for assessing the damage to crops. The manual elaborated features free living game which cause serious damage to field crops. Pictures of main types of damage to crops are also included.

In general, damage to leaves caused only a small reduction of the yield. Winter wheat or barley crops were not influenced by a considerable reduction of leaves. Only yield of sunflower and winter rape was significantly lower in defoliated plants. Crop damages at the later stages of plant development were more important. In fields connected to the forest edge 5–50% plants were damaged. Our method allows to make accurate estimates of the extent of damages. The study provides practical guidelines for state agencies, wildlife managers and farmers.

Wild boar rooting in a pasture. (Photo by J. Kamler)
International Cooperation

Feeding behaviour, parasite infections and self-meddicative abilities of an introduced chimpanzee population

The chimpanzee population on Rubondo Island results from an introduction of 17 individuals in the late 60ties and it is the only example of a viable, long-term self-sustaining released chimpanzee population with a minimum of human intervention at the time of release and afterwards. Our on-going research is aimed to study these chimpanzees as a model population adapted to a new environment from the aspects of feeding behaviour, self-medication, and parasite exchange among released chimpanzees and colobus monkeys (Colobus guaraza) and indigenous velvet monkeys (Cercopithecus aethiops). Obtained results will contribute to our understanding of chimpanzee behavioural and ecological flexibility and are supposed to help to increase the success of next releases.

We examined the relationship between fruit availability, dietary composition and grouping in the descendents of an introduced chimpanzee population on Rubondo Island. Tree fruit
availability was positively correlated with rainfall, with a period of relative tree fruit scarcity corresponding with the long dry season. Liana fruit availability was not related to rainfall, and lianas exhibited more stable fruiting patterns across seasons. Fruits made up the majority of chimpanzee diet, with lianas accounting for 35% of dietary fruit species. Fruits of the liana *Saba comorensis* were available during all months of phenological monitoring, but they were consumed more when tree fruit was scarce, suggesting that *S. comorensis* fruits may be a fallback food for Rubondo chimpanzees. There were no increases in consumption of lower-quality plant parts between seasons, and there were no changes in nesting group size between seasons. These results contrast with evidence from several endemic chimpanzee study sites, and indicate that Rubondo chimpanzees may experience fewer ecological constraints on dietary quality and grouping patterns.

We identified three nematode species not previously reported in chimpanzees (*Pan troglodytes*) introduced on Rubondo Island, Tanzania: *Protospirura muricola*, *Subulura* sp., and *Anatrichosoma* sp. The chimpanzee pinworm, *Enterobius anthropopitheci* was redescribed based on light and scanning electron microscopy of both sexes collected from the feces of Rubondo chimpanzees.


Mother and baby chimpanzee. (Photo by K. J. Petrželková)
Body proportion and bone biomechanics of the Tyrolean “Iceman” (Ötzi)

Body mass and structural properties of the femoral and tibial midshafts of the “Iceman” (Ötzi), a late Neolithic (5200 BP) mummy found in the Tyrolean Alps, are determined from computed tomographic scans of his body, and compared with those of a sample of 139 males spanning the European Early Upper Paleolithic through Bronze Age. Two methods, based on femoral head breadth and estimated stature and bi-iliac (pelvic) breadth, yield identical body mass estimates of 61 kg for the Iceman. In combination with his estimated stature of 158 cm, this indicates a short but relatively wide, or stocky body compared to our total sample. His femur is about average in strength for Neolithic males, but his tibia is well above average. His femur also shows adaptations for his relatively broad body (mediolateral strengthening), while his tibia shows adaptations for high mobility over rough terrain (anteroposterior strengthening). In many respects his tibia more closely resembles those of European Mesolithic rather than Neolithic males, which may reflect a more mobile lifestyle than was characteristic of most Neolithic males, perhaps related to a pastoral subsistence strategy. There are indications that mobility in

Transverse CT scans through pelvic region (a) and CT scans of femoral heads used for body size estimate (b) (Iceman, 5200 B.P.). Left femur is post-mortem dislocated from acetabulum.
general declined between the European Mesolithic and Neolithic, and that body size and shape may have become more variable throughout the continent following the Upper Paleolithic.

The research was leaded by Christopher Ruff (Johns Hopkins University School of Medicine) with cooperation from United States (Brigitte Holt, University Massachusetts; William A. Murphy, University of Texas), Czech Republic (Vladimír Sládek, Institute of Vertebrate Biology) and Austria (Margit Berner, Naturhistorisches Museum; Dieter zur Nedden, Wolfgang Recheis, University of Innsbruck; Horst Seidler, University of Vienna).

RUFF C., HOLT B., SLáDEK V., BERNER M., MURPHY W.A., NEDDEN D., SEIDLER H., RECHEIS W., 2006: 
OBITUARY

Zdeněk Veselovský
(1928–2006)

Professor Zdeněk Veselovský was a distinguished zoologist who was a source of great inspiration to generations of ornithologists, mammalogists, and behavioural biologists in the Czech Republic. He was born in Jaroměř on 26 August 1928 and died on 24 November 2006 in Prague.

Zdeněk Veselovský was a naturalist of very broad competence, and his skills for popularization of the animal world to wide public were particularly recognized and appreciated. He was the author of more than 100 research papers and he published 35 books and textbooks. He had worked for almost 30 years as the director of the Prague ZOO (1959–1988), and he was later appointed as the professor of zoology at universities in České Budějovice and Prague.

He was a research fellow of the Institute during a short period in 1992 and 1993. This employment, provided by the Academy of Sciences, was quite important for Zdeněk Veselovský, because it enabled him to continue his scientific career in uneasy times of his life.

Zdeněk Veselovský was a man with great enthusiasm, curiosity and love of nature. His deep knowledge and warm friendly personality will be greatly missed by many.
AWARDS

In 2004, Zdeněk Hubálek was awarded the Prize of the Academy of Sciences of the Czech Republic for his studies on biology of West Nile virus, the agent of encephalitis in some vertebrates including humans. The results were published in 17 scientific papers and received a wide international response (the principal 1999 paper has been cited 224 times up to February 2007). Zdeněk Hubálek’s long-term research concentrates on the ecology of arthropod-borne viruses and bacteria pathogenic for vertebrates, such as arboviruses and Lyme disease borreliae, and his papers have been cited almost 1 400 times. He has been assessing potential role of free-living birds in dispersal of pathogenic bacteria and viruses and is involved in the EDEN project of the 6th Framework Programme (West Nile virus, tick-borne diseases). Z. Hubálek is a member of two expert commissions of WHO.

In 2005, Martin Reichard was awarded the Otto Wichterle Prize for his studies on general processes in population, behavioural and evolutionary biology. He uses fishes as a model group. His current research has concentrated on the evolution of reproductive strategies and mating systems, co-evolutionary dynamics and the effect of individual behaviour on population processes. He further investigates the ecology of early developmental stages of fish with a special attention to larval dispersal and the effects of biotic and abiotic factors on the success of natural reproduction. He is also involved in several projects on the ecology of tropical fishes in Senegal, Bangladesh, and China.
In 2006, the rector of Czech University of Agriculture in Prague awarded Vlastimil Baruš, director of the former Institute of Vertebrate Zoology and the Institute of Systematic and Ecological Biology CS AS, a commemorative medal which was struck in honour of the 100th anniversary of the university.

The Otto Wichterle Prize award ceremony 2005. Martin Reichard (left) receives the Otto Wichterle Prize for young scientists from the president of the Academy of Sciences of the Czech Republic Václav Pačes (right). Photo by M. Hužvárová.

Commemorative medal of Czech University of Agriculture in Prague.
INTERNATIONAL ACTIVITIES

The Institute’s international collaboration is a very important part of its all research activities. Our scientists work in close collaboration and exchange their views with scholars from various institutions in many countries. Each department is involved in various forms of international co-operation and we have recently been participating in 20 international projects including six projects within the EU Sixth Framework Programme. We have been deriving much benefit from established links with foreign laboratories, however, we use any opportunity to find new contacts. The Institute organizes scientific meetings, offers study visits to foreign students and supports participation of our specialists in major scientific events abroad. Great emphasis is placed on young scientist-centred educational stays. Our scientists are members of 38 international organizations and 8 editorial boards, respectively.

International scientific meetings organized by the Institute

- 8th SE European Bird Migration Network Workshop, Prague, Czech Republic, February 2–5, 2006

The 8th Workshop of Southeast European Bird Migration Network (SEEN) was jointly organized by the Institute of Vertebrate Biology and the Faculty of Science of Charles University. SEEN workshops present a fruitful discussion platform for investigators of avian migration along the less studied southeastern European flyway. A total of 46 participants from 15 countries attended the workshop. The majority of the studies reported on results of orientation experiments, however, several participants demonstrated that also other approaches, such as satellite telemetry or stable isotope analysis are being adopted. These modern methods have challenged the traditional view of avian migrations and enable to answer hitherto unthinkable questions. An important lecture was held by Zdeněk Hubálek from the Department of Medical Zoology, Institute of Vertebrate Biology of the ASCR on avian influenza, followed by a discussion how the network could contribute to the understanding of possible spread of the H5N1 virus. The next workshop will be held in Kraków in 2007.


Long-term tradition of the “Zoological days” conference goes back to 1969 and it is connected with the Institute of Vertebrate Biology and the former Institute of Vertebrate Zoology. Nevertheless, its scope and contents has changed as all lifestyle in the Czech Republic after the velvet revolution in 1989. Former meeting of Czech and Slovak zoologists serving as forum of the Czech Zoological Society (co-organizer) became a serious yearly scientific conference where mainly students and young researchers present actual results of their research focussed on various aspects of both vertebrate and invertebrate zoology. The student competition is organized thanks to the sponsorship of the OLYMPUS company which became a regular co-operative partner of the conference. In 2006, six students received awards for their outstanding presentations. Since students presented at least half of all posters and lectures (total number of presentations: 143 lectures and 136 posters) this sponsorship was a great help. Since 2003, the conference has been held at the Faculty of Science, Masaryk University Brno (co-organizer) and approximately 350 both professional and amateur zoologists from the Czech and Slovak Republics participated in it every year.
Participation in international conferences

- ESF BIRD Final Conference, Wilhelmshaven, Germany, February 16–20, 2005
- Man and Biosphere Meeting, Simenti, Senegal, March 1–2, 2005
- Annual International Symposium FSBI: Fish Habitat Ecology and Conservation, Bangor, Wales, United Kingdom, July 18–22, 2005
- 9th International Congress of Mammalogy, Sapporo, Japan, July 31 – August 5, 2005
- 10th Congress of European Society for Evolutionary Biology, Krakow, Poland, August 15–20, 2005
- 29th Ethological Conference, Budapest, Hungary, August 20–27, 2005
- 5th Conference of the European Ornithologists’ Union, Strasbourg, France, August 20–23, 2005
- 10th European Bat Research Symposium, Galway, Ireland, August 21–26, 2005
- 13th Meeting of the International Hamsterworkgroup, Illmitz, Austria, October 14–17, 2005
- 5th Asia-Pacific Congress of Entomology, Jeju, South Korea, October 18–21, 2005
- European Otter Workshop, Padula, Italy, October 20–23, 2005
- Ecology of Stream Fish: State of the Art and Future Prospects II, León, Spain, June 12–16, 2006
- EIFAC International Symposium, Mondsee, Austria, June 12–17, 2006
- Genetics of speciation, Vancouver, Canada, July 21–24, 2006
- Behavioral Ecology Congress, Tours, France, July 23–30, 2006
- International Congress of Parasitology, Glasgow, United Kingdom, August 6–11, 2006
• 24th International Ornithological Congress, Hamburg, Germany, August 13–19, 2006
• 36th International Conference, International Association for Danube Research, Vienna, Austria, September 4–8, 2006
• Applied Ornithology 2006, Zvolen, Slovakia, September 8–9, 2006

Membership in international organizations

ALBRECHT T. International Society for Behavioral Ecology (ISBE)
BARUŠ V. Sociedad Cubana de Parasitología Animal, honorary chairman
BÍMOVÁ B. International Mammalian Genome Society
BRYJA J. Steering Committee of European Science Foundation
ČAPEK M. IOC Standing Committee on Ornithological Nomenclature
ČERVENÝ J. Ad Hoc Group for Environmental Problems of COST (Council for Research and Development, EU)
Czech National Committee of the MAB Programme
Working Group for Large Carnivores Initiative for Europe
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British Herpetological Society
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HONZA M. Steering Committee of European Science Foundation
JURAJDA P. Fisheries Society of British Isles
MARTíNKOVá N. Society of Systematic Biologists
MRLíK V. Peregrine Fund, World Center for Birds of Prey
Working Group for Montagu’s Harrier
World Working Groups on Birds of Prey and Owls
KOUBEK P. Working Group for Large Carnivores Initiative for Europe
PIáLEK J. European Society for Evolutionary Biology
International Mammalian Genome Society
Societas Europea Herpetologica
Society for the Study of Amphibians and Reptiles
Society for the Study of Evolution
PROCHÁZKA P. Deutsche Ornithologen-Gesellschaft
REICHARD M. Association for the Study of Animal Behaviour
British Ecological Society
European Society for Evolutionary Biology
Fisheries Society of the British Isles
SLáDEK V. Paleoanthropology Society (USA)
ZIMA J. Czech National Committee of the IUBS
International Advisory Board, BIOTER Centre of Excellence (EU)
Insectivores Specialits Group SSC IUCN
International Sorex araneus Cytogenetics Committee
Rodents Specialists Group SSC IUCN
Societas Europaea Mammalogica
Membership in editorial boards

BARUŠ V. Transactions of the Zoological Society of India
Helminthologia
BŁAHÁK, P. Folia Zoologica (managing editor)
GVOŽDÍK, L. Folia Zoologica
HONZA M. Folia Zoologica
HUBÁLEK Z. Cryobiology
Folia Parasitologica
KOUBEK, P. Folia Zoologica
LUSK S.: Folia Zoologica
PEŇÁZ M. Folia Zoologica (editor-in-chief)
Quaderni E.T.P. – Journal of Freshwater Biology
Polskie Archiwum Hydrobiologii
SLABÁKOVÁ H. Folia Zoologica
ZIMA J. Hystrix – Italian Journal of Mammalogy
Folia Zoologica
EDUCATION AND TEACHING ACTIVITIES

The Institute lays great emphasis on education and teaching activities. In 2005–2006, we gave lectures at seven faculties of seven universities and supervised 61 undergraduates and 53 postgraduates from 11 faculties of eight universities. Another important fact is that 19 and 9 students supervised by the staff succeeded in obtaining their MSc and PhD degrees, respectively. We have accreditation from the Ministry of Education, Youth and Sports of the Czech Republic to perform post-gradual studies in zoology at the Faculty of Science, Masaryk University in Brno, and the Faculty of Biological Sciences, South Bohemian University in České Budějovice. We participate in research projects carried out in two joint laboratories, "Evolutionary Genetics of Animals" (established by the Department of Zoology, Faculty of Science, Charles University in Prague, the Institute of Animal Physiology and Genetics AS CR in Liběchov and the Institute of Vertebrate Biology in Brno) and “Ichthyoparasitology – The Centre of Basic Research” (established by the Faculty of Science, Masaryk University in Brno and the Institute of Vertebrate Biology in Brno). These laboratories provide a firm basis for better interaction between the Academy of Sciences CR and universities, which helps to make the institute attractive to students. Moreover, the scientists of the Institute are members of scientific councils and boards at universities.

Teaching at universities

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<td>Faculty of Biological Sciences, University of South Bohemia, České Budějovice</td>
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Total | 53 | 16 | 47 | 46 | 9 | 6/5 |
EDITORIAL ACTIVITIES

The „Institute“ publishes the international journal „Folia Zoologica“. The journal is covered by many reference journals, including the Current Contents. The current value of the impact factor for 2005 amounts 0.585.

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PREFACE

I am glad to introduce this traditional report summarizing the main results of scientific activities of the Institute during the last two years. The most important event in this period was the transformation of the Institute into a public research institution. This process was completed at the end of 2006.

The Academy of Sciences of the Czech Republic has undergone profound changes in relation to varied scientific and organisational aspects since its foundation in 1993. This transformation included also human resources and the Academy has become a modern, democratically administrated cluster of autonomous, non-university research institutes. The institutes of the Academy of Sciences were state contributory organisations, which was quite unusual legal form within the European Union. The legal subjectivity of the institutes was restricted, and this fact weakened their independency in respect of both the economic area and the cooperation with other subjects.

The acceptance of Act No. 341/2005 Coll. on Public Research Institutions made it possible to remove these deficiencies. The act introduced a new form of legal entity – a public institution, with principal activities in the research area and with significant provision of an infrastructure for research. Besides the main research performance, the Institute may now realize also secondary and other activities for profit, subject to legal restrictions.

After January 1, 2007, further transformation steps follow. The members of the Council of the Institute have been elected, and public competition for the post of the director has been announced. All these changes will certainly have a profound influence on the life and the research performance of the Institute in the future.

The last two years can be considered fruitful for the Institute and its staff. The fellows were particularly successful in raising funds for grant projects. The institutional budget assigned from the state contribution in the frame of the Institutional Research Plan achieved approximately 22 and 23 million CZK in 2005 and 2006, respectively. Additional 14 million CZK were provided in both the years for investment into laboratory equipment and maintenance of buildings. Research grants and diverse contracting funding contributed to the budget with 16 and 26.5 million CZK in 2005 and 2006, respectively.

In the previous two years, the Institute employed 61 fellows paid from the institutional sources, and additional 36 fellows were contracted on the basis of research grant funding. In the respective period, 18 foreign workers were employed.

The scientific achievements of the Institute are summarized in the list of publications. Altogether, 267 scientific contributions authored by the fellows of the Institute were published in 2005–2006. Almost 100 papers appeared in international journals included in databases of the Web of Science. The total impact factor of these publications was 69.7 in 2005 and 67.1 in 2006, what indicates a remarkable increase in comparison with 2003 and 2004 (total impact factor of 40.4 and 46.9, respectively). I hope the Institute will continue this successful development towards research excellence also in the next years.

Jan Zima

Jan Zima

Scientific Council

Director

Advisory Committee

Scientific Secretary

Deputy Director

Principal Scientific Divisions

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Department of Population Biology

Department of Ichthyology

Department of Fish Ecology

Department of Avian Ecology

Department of Mammalian Ecology

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Editorial Office

Economic Department

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Assoc. Prof. RNDr. Zdeněk REHÁK, PhD
(Masaryk University, Brno)
RESEARCH PROJECTS

Institutional Research Plan


Projects supported by the Grant Agency of the Academy of Sciences of the Czech Republic

IAA6093403 Evolutionary determinants of brood parasitism in ducks – P. Musil (Charles University, Prague), M. Honza (IVB AS CR), 2004–2008
IAA6093404 Species diversity and ecology of selected West African vertebrates – P. Koubek (IVB AS CR), M. Gelnar (Masaryk University, Brno), P. Hejcmanová (Czech University of Agriculture, Prague), 2004–2008
IAA600930605 Evolution of antiparasitic strategies of selected hosts towards avian brood parasitism – M. Honza, 2006–2010
IAA600930608 The role of MHC in sexual selection – observational and experimental study in three model vertebrate species – J. Bryja (IVB AS CR), A. Šimková (Masaryk University, Brno), 2006–2008
IBS5045111 Molecular and other genetic markers applied in conservation of populations of endangered, rare and vanishing fish species in the Czech Republic – P. Ráb (Institute of Animal Physiology and Genetics AS CR, Liběchov), V. Lusková (IVB AS CR), 2001–2005
KJB600930508 European reed warbler populations across a migratory divide: insights into migration by analyses of DNA sequences, stable isotopes and ringing recoveries – P. Procházka, 2005–2007
KJB600930613 Diversity of cultivable microorganisms of ixodid ticks, recognized vectors of vertebrate pathogens – I. Rudolf (IVB AS CR), P. Švec (Masaryk University, Brno), 2006–2008

Projects supported by the Grant Agency of the Czech Republic


GA206/03/0757 Assessment of population size and population structure of Eurasian otter (Lutra lutra) in different habitats by a non-invasive genetic method – J. Zima, 2003–2005

GA206/04/2003 Ecological interactions in populations of small rodents – E. Tkadlec (Palacký University, Olomouc), I. Pavlik (Veterinary Research Institute, Brno), M. Heroldová (IVB AS CR), 2004–2006


GA206/06/0953 Phenotypic plasticity of thermal physiology traits in newts – L. Gvoždík, 2006–2008


GA524/03/0061 Comparative studies on dracunculoid nematodes, with special reference to agents of serious diseases of fish – F. Moravec (Institute of Parasitology AS CR, České Budějovice), V. Baruš (IVB AS CR), 2003–2005

GA524/04/1115 Fluctuating asymmetry in fish parasites: a new approach to assess environmental stress of aquatic ecosystem? – B. Koubková (Masaryk University, Brno), M. Machala (Veterinary Research Institute, Brno), P. Jurajda (IVB AS CR), 2004–2006

GA524/04/1128 MHC class IIB genes of European cyprinid fish: their genetic variability and evolution in relation to the host life-history traits and parasitism – A. Šimková (Masaryk university, Brno), P. Jurajda (IVB AS CR), 2004–2006


GA524/06/0687 Importance of red fox in different ecosystems of Central Europe – J. Červený (IVB AS CR), M. Andéra (National Museum, Prague), K. Šťastný (Czech University of Agriculture, Prague), 2006–2008

GD524/05/I1536 Evolutionary ecological analysis of biological systems: research center for PhD studies – M. Chytrý (Masaryk university, Brno), P. Jurajda (IVB AS CR), 2005–2008

GP206/03/P134 Feeding strategy of large herbivore mammals between forest and field habitats – J. Kamler, 2003–2005
GP206/06/P152 Reproductive isolating mechanisms in *Nothobranchius* fishes (Aplocheilidae) – M. Reichard, 2006–2008

GP206/06/P302 Genetic structure of black grouse populations in the Czech Republic – J. Svobodová, 2006–2008

GP524/05/P291 Parasitism and invasive species: effect of parasite infection on the biology of *Neogobius kessleri* in its native and introduced range – M. Ondračková, 2005–2006

Projects supported by the Ministry of Agriculture

GAZV QF3028 Development of new technologies of rearing commercially important riverine species of fish and crayfish endangered by environment degradation – P. Kozák (University of South Bohemia, České Budějovice), J. Barthová (Charles University, Prague), P. Spurný (Mendel Agriculture and Forestry University, Brno), S. Navrátil (University of Veterinary and Pharmaceutical Sciences, Brno), M. Prokeš (IVB AS CR), 2003–2007

GAZV QF3029 Harmonization with the EU in application of the principles of pharmacovigilancy in aquaculture in the Czech Republic – V. Piačková (University of South Bohemia, České Budějovice), J. Hajšlová (Institute of Chemical Technology, Prague), Z. Svobodová (University of Veterinary and Pharmaceutical Sciences, Brno), M. Prokeš (IVB AS CR), T. Barth (Institute of Organic Chemistry and Biochemistry AV CR, Prague), 2003–2007

GAZV QF4192 Methodology of evaluation of damages caused by game to field crops – J. Kamler (IVB AS CR), J. Dvořák (Mendel Agriculture and Forestry University, Brno), 2004–2006

Projects supported by the Ministry of Environment


Management plan of large carnivores (brown bear, wolf, lynx) in the Czech Republic – P. Koubek, 2003–2005

Projects supported by the Ministry of Education, Youth and Sport


LC06073 Biodiversity Research Center – P. Kindlman (Institute of Systems Biology and Ecology AS CR, České Budějovice), and other seven partners, including J. Zima (IVB AS CR), 2005–2011

International projects

European Union – 6th Framework Programme

**Integrated project EDEN** (no. 010284-2) Emerging diseases in a changing European environment (coordinated by CIRAD Montpellier, France) – Z. Hubálek, 2004–2008

Integrated consortium on ticks and tick-borne diseases (ICTTD - 3) - L. Grubhofer (Biology Center AS CR, České Budějovice), Z. Hubálek (IVB AS CR), 2004–2008

Marie Curie research training network SEXASEX (no. MRTN-CT-2004-512492) Sex to asex: a case study on transitions and coexistence between sexual and asexual reproduction (coordinated by the Royal Belgian Institute of Natural Sciences, Belgium) - J. Zima, 2004–2009

Marie Curie intra-European fellowship PHYLOMICROTUS (no. 24956) Phylogeography of the Orkney vole Microtus arvalis orcadensis (cooperation with University of York, UK) - N. Martínková, 2006–2008

Project INTAS (no. 03-51-4030) A multidisciplinary study of hybrid zones in the common shrew (coordinated by the University of York, UK) - J. Zima, 2004–2007

Other EU projects

European Science Foundation Research Networking Programme Integrating population genetics and conservation biology: Merging theoretical, experimental and applied approaches - J. Bryja (member of the steering committee), 2004–2009

European Science Foundation Research Networking Programme Thermal adaptation in ectotherms: Linking life history, physiology, behaviour and genetics - L. Gvoždík (member of the steering committee), 2006–2011

Large Scale Facility Project (no. HPRI-CT-2001-00180) Intraspecific diversity in selected cyprinid fish species in the conditions of Central Europe (coordinated by the Institute of Aquaculture, University of Stirling, Scotland, UK) - J. Mendel, 2005

Bavarian Interreg-III A-Project Wildlife and human in Bavarian-Czech-Austrian border region - example of the otter (cooperation with the Bavarian Forest Institute and Technical University of Munich, Germany) - P. Hájková, 2006–2007

IUCN and European Commission Assessment of European mammal species - J. Zima (participant), 2006–2007

Bilateral projects


Programme KONTAKT (project no. 26) Zoogeography, taxonomy and phylogeography of mammals in south-eastern Europe, Asia Minor and South Africa - V. Vohralík (Charles University, Prague), J. Zima (IVB AS CR), B. Kryšťufek (University of Primorska, Koper, Slovenia), 2005–2006

Programme KONTAKT (project no. 144) Variability of social system in Apodemus mice (Rodentia) - M. Stanko (Institute of Zoology SAS, Bratislava, Slovakia), J. Bryja (IVB AS CR), 2004–2005

Austrian Science and Research Liaison Office Brno Bioarchaeology of the Holocene populations of Central Europe: reconstruction of mobility and manipulative behaviour - V. Sládek (IVB
AS CR), M. Berner (Naturhistorisches Museum, Wien, Austria), P. Galeta (University of West Bohemia, Plzeň), 2006

**Integrated Bilateral Project** Development of new methods for the laboratory diagnostics of West Nile Virus disease in human and some other animals (cooperation with Istituto Zooprofilatico e Sperimentale, Teramo, Italy) – Z. Hubálek, 2004–2005

Individual projects

**Leverhulme Trust (UK),** project Adaptation and coevolution in an unusual symbiosis (cooperation with University of Leicester, UK) – M. Reichard, 2003–2005

**Natural Environment Research Council (UK),** project Stoats and the Irish question (cooperation with University of York, UK) – N. Martinková, 2005

**The Leakey Foundation (USA),** general grant The possible role of ciliate (*Troglodytella abrassarti*) in chimpanzee hind gut fermentation – K. Petrželková, 2006–2007.

**British Ecological Society (UK),** early career project grant (ref no. 551-617) Phenotypic correlates of lifetime reproductive success in the bitterling fish – M. Reichard, 2006–2007
LIST OF PUBLICATIONS

Books, textbooks, edited proceedings


Chapters in books


Papers in journals included in the databases ISI Web of Knowledge


Papers in proceedings


Book reviews


**Popularization books and articles**


PRINCIPAL SCIENTIFIC DIVISIONS

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Research priorities

Research is focused on the ecology of selected microbial pathogens (including new emerging diseases), the causative agents of human and animal infections. The phenomenon of natural focality is studied in respect of the role of wild endotherm vertebrates (hosts or reservoirs) and hematophagous arthropods (vectors) and under effects of the recently globally changing natural conditions.

Main research topics:

- arboviruses (i.e. viruses transmitted by ticks, mosquitoes and other hematophagous arthropods, such as the West Nile, Sindbis, Ťahyňa, and tick-borne encephalitis viruses)
- spirochetes (Borrelia burgdorferi, the agent of Lyme borreliosis) and some other bacterial agents
- circulation of these pathogens in terrestrial and aquatic ecosystems under changing natural conditions including human impact
- development and optimisation of a new molecular-biological methods for the detection and characterization of the pathogens studied
- prophylactic strategy establishment and prevention of free-living vertebrates and humans in relation to preventive medicine (human and veterinary), environmental protection, and nature conservation
Selected research results

Migratory birds and avian influenza A virus H5N1 - its spread in Eurasia, possible introduction to America and continental dispersal

Water anseriform birds are the reservoir of a majority of influenza A viruses, including highly pathogenic avian influenza (HPAI). Marked lethality of its H5N1 subtype seemed to limit the role of migratory birds in the dispersal. However, the situation changed as HPAI H5N1 virus has expanded rapidly across Asia and into Europe and Africa, and migratory birds contributed to this dispersal. Birds could theoretically introduce H5N1 virus to the Western Hemisphere through migration, vagrancy and translocation by people (bird trade). Vagrants and migratory birds are not likely inter-hemispheric introductory hosts; import of infected domestic or pet birds is more probable. In the case of successful introduction, the virus might spread over the continent easily, with migratory anseriform birds (swans, geese, and ducks) playing a similar role as in Eurasia.

HUBÁLEK Z., 2006: Migratory birds and influenza virus. 8th Workshop of the Southeastern European Bird Migration Network (SEEN), Prague, abstract.
Import of West Nile virus infection in the Czech Republic

We report West Nile virus infection of the central nervous system in a 69-year-old man, residing in North Moravia (Czech Republic), who visited the USA from 6 July to 31 August 2002. He developed fever with fatigue at the end of his USA stay. He was hospitalized after his return with fever up to 39.5 °C, fatigue, anorexia, dizziness, insomnia, blurred speech, and a marked bradypsychism. A significant increase of antibodies neutralizing West Nile virus was detected between the first (1:16) and second (1:256) blood serum sample. The patient recovered gradually. This is the first recorded human case of West Nile fever imported to the Czech Republic.


Applications of research results

Effects of forest clearing on the abundance of Ixodes ricinus ticks and the prevalence of Borrelia burgdorferi s.l.

Questing Ixodes ricinus ticks were collected on a forest trail that had been completely cleared of shrubs and ground vegetation in winter 2002 and on a nearby control uncleared forest transect in South Moravia (Czech Republic). Samples were collected each May in 2003, 2004 and 2005. Nymphal ticks were 3.4, 1.9 and 1.2 times less frequent on cleared forest than on uncleared trails in the three perspective years, whereas adult tick abundance was 27.2, 4.0 and 39.5
2.2 times lower, respectively. The ticks were examined for borreliae by dark-field microscopy: prevalence of nymphal ticks infected with *Borrelia burgdorferi sensu lato* (12.6% to 20.0%) did not differ significantly between the cleared and uncleared trail during the three years. In conclusion, the habitat modification appeared to result in a decreased abundance of *I. ricinus* as well as a reduced frequency of infected ticks (and thus indirectly a lower potential risk of Lyme borreliosis), which lasted, however, for only two years. Eight cultures of borreliae isolated from the ticks were all identified as the „ornithophilic“ genomic species *Borrelia garinii*, possibly indicating a greater role of forest birds than that of forest rodents as the hosts of immature *I. ricinus* in the tick (and borrelial) colonization of the cleared part of the forest.


L. Ševčíková handling biological material in a hazard box. (Photo by I. Rudolf)
International cooperation

Prevalence of *Borrelia burgdorferi* sensu lato in the tick *Ixodes ricinus* in the Styrian Mountains of Austria

A total of 691 *Ixodes ricinus* ticks (22 males, 39 females, 501 nymphs and 129 larvae) were collected by flagging method from vegetation in 11 areas at altitudes between 789 and 1350 m above sea level in mixed woodland with pastureland and cattle in the province of Styria (Austria). They were examined for presence of *Borrelia burgdorferi* s.l. by dark field microscopy and PCR. Attempts to cultivate borreliae were made in BSK-H medium. The overall positivity rate of all collected ticks (excluding larvae) was 10.9%: 9.1% in males, 17.9% in females and 10.4% in nymphs. The larvae examined showed no presence of *B. burgdorferi* s.l. The mean infection rate of the vector of Lyme disease in the collection area of the highest altitude in this study – and the highest reported in Europe (Gaberl, 1350 m a.s.l.) was 6.4%: 1/9 males, 2/18 females, and 6/114 (5.3%) nymphs were positive. Culture attempts were positive in 12 cases and species identification showed eight isolates of *Borrelia afzelii* and four of *Borrelia garinii*. Three additional positive results found by PCR method (negative by dark field microscopy) were identified twice as *B. afzelii* and once as *B. garinii*. This study showed that the risk of acquiring of Lyme disease in habitats at higher altitudes is limited due to a lower density of *I. ricinus* and lesser infection rate of ticks than at lower altitudes in Central Europe, nevertheless it does exist.


I. Rudolf preparing samples for PCR procedure. (Photo by J. Halouzka)
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Research priorities

The studies are performed on both laboratory and natural populations. Empirical data from observations and experiments supplemented by simulation modelling are used to investigate important questions of evolutionary biology, such as (model organisms given in parentheses):

- hybrid zones as barriers against gene flow and their role in speciation (*Mus, Sorex, Triturus*)
- study of factors affecting population structure (fish, bats and mammals)
- links between life history traits, adaptive genetic variation and population dynamics in small mammals (voles)
- phylogeography and reconstruction of historical colonization (*Mustela, Clethrionomys, Microtus*)
- analysis of reproductive success by using DNA markers (paternity analyses in fish, birds and mammals)
- conservation genetics of endangered vertebrate species (*Lutra, Rupicapra*); development of non-invasive techniques of DNA sampling
- mechanisms and evolution of thermal physiology traits in ectotherms (*Triturus*)
- functional approaches in studying morphological adaptations (*Zootoca, Triturus*)

The results of these investigations are used in preparing recommendations for nature conservation, rodent pest control, lecturing at universities in Brno, České Budějovice, Prague, and Olomouc.

Selected research results

**Behavioural and genetic study of speciation in a hybrid zone in the house mouse, *Mus musculus***

Two house mouse subspecies, *Mus m. musculus* and *M. m. domesticus*, form a long and narrow hybrid zone (HZ) running in Europe from Denmark to the Black Sea. Despite long-term interest in the study of this contact zone we have still a limited information about proximate mechanisms maintaining the HZ and thereby keeping the parental taxa in parapatry. To solve this question, we conducted a study of another part of the mouse HZ within the last 10 years. Based on maximum-likelihood analysis of more than 1500 mice from 105 localities we characterized the Czech-Bavarian transect across the HZ [1]. While most of molecular markers show similar transition in terms of frequencies from one taxon to another we found that one marker located on mitochondrial DNA is shifted from the centre and this shift is random when two transects are compared [2]. To determine factors keeping the two mouse
taxa apart and preventing intermixing of their genomes, we transported some mice to the laboratory and studied fitness components of parental and hybrid individuals. Behavioural studies focusing on assortative mating indicate that salivary signals (androgen-binding protein) most probably participate on subspecies specific recognition but in themselves are not efficient.

(A) The course of the *musculus/domesticus* hybrid zone in Europe. Circles indicate previously studied transects in Denmark, Germany and Bulgaria. In the insert, the position of the Czech study area is indicated. (B) Location of 105 sampling sites. The thick dashed line is an approximate zone center defined as a 0.5-isocline derived from the bicubic spline smoothing of allele frequencies at each site.
enough to noticeably impede gene flow [3]. Hybrid male sterility is among presumed factors which can prevent gene flow between diverging subpopulations and in a pivot study we showed that genes causing spermatogenetic breakdown are polymorphic and widespread in wild *M. m. musculus* [4].


**Non-invasive genetic sampling**

Genetic studies of elusive or endangered species are often constrained by difficulties in obtaining sufficient number of samples. We optimised the method and increased the success rate of otter (*Lutra lutra*) faeces genotyping using microsatellite and SRY markers. The optimised method was used to estimate population size and structure of free-ranging otters in two different habitats without any contact or disturbance of animals. Complete reliable genotypes were obtained from 60% of samples. Together with tissues from otter carcasses (mostly road-kills), faecal samples were used to study genetic variability, structure and demographic history of otter populations in the Czech and Slovak Republics. Throughout analyses, strict recommendations to avoid contamination and genotyping errors were followed.

In another study, we successfully applied non-invasive approach on PCR-based test for species identification of two cryptic bats *Pipistrellus pipistrellus* and *P. pygmaeus*. DNA analysis of droppings obtained during trapping or other handling of individuals can substitute the punching of wing-membranes. The results can be potentially obtained even without contact with animals, e.g., using fresh droppings from day roosts.

Another valuable source of samples for molecular genetic studies is museum collections. We have been able to perform a comprehensive phylogeographic research of a stoat (*Mustela erminea*) using mitochondrial DNA sequences from DNA isolated from museum skin collections. We took particular care to ensure authenticity of sequences from the museum samples using methods derived from laboratory protocols for handling ancient DNA.


Applications of research results

Implementation of the Convention on Biological Diversity in the Czech Republic

In May of 1999 the UN Development Programme and the Global Environmental Facility announced a capacity development initiative that was intended to support effective implementation of international agreements adopted under the auspices of the United Nations, concerned with improving the state of the environment on the Earth. On the basis of this Initiative, a National Capacity Self-Assessment project was commenced to perform thorough analysis of conditions in implementing the three international agreements, adopted at the UN Global Conference on the Environment and Development, held in 1992 in Rio de Janeiro. The analysis is intended to lead to identification of capacity constraints for meeting the obligations of states following from these agreements and to the preparation of an action plan to improve the situation. Thus, this assessment is intended to evaluate the state of preparation of the Czech Republic for implementation of the objectives of the Convention on Biological Diversity. An evaluation is made of the level of strategic planning and proposal of individual steps and prospects, and problems are sought that can be identified as being critical from the standpoint of achieving the intermediate and final targets. In order to provide for the intentions formulated in the Convention, it is above all necessary to create and develop suitable capacities at the individual, institutional and systemic levels. This approach is fundamentally promoted in the assessment.


 Threatened mammal species, Eurasian otter *Lutra lutra*, can be studied using non-invasive genetic methods (Photo by J. Roleček).
The first gorilla born in the Czech Republic is a girl

The first offspring of the western lowland gorilla in the Czech Republic was born at the Prague ZOO in December 2004. This birth received great publicity and has been popularized in various TV and radio-broadcasting programmes. However, the gender of the young remained enigmatic. Two independent laboratories performed genetic studies aimed to sex identification of the individual but their results appeared contradictory.

The Institute was then asked by the authorities of the Prague ZOO to make additional investigations. The suitability of the genetic sex identification was tested by using blood samples of adult gorillas of known sex. Duplex PCR was conducted to amplify parts of the Sry gene (occurring only in males), whereas the Zfy-Zfx gene (amplified in both sexes) was used as a positive control of a PCR reaction. Then we used fresh samples of faeces for DNA extraction and amplification in the young and its father. The results showed unequivocally that the young named Moja is a female.

International cooperation

Historical and contemporary selection on major histocompatibility complex genes in cyclic rodents

Host-pathogen interactions are of particular interest in the understanding of the interplay between population dynamics and natural selection. The genes of major histocompatibility complex (MHC) of demographically fluctuating species are very suitable markers for this purpose because they are involved in the initiation of the immune response against pathogens.
and they exhibit high levels of genetic variation that are proposed to be adaptive in natural vertebrate populations. We optimised single strand conformation polymorphism analysis method using capillary electrophoresis to study polymorphism of DNA sequences in large scale population studies [1] and applied this method to analyse the variation of two MHC Class II genes (DQA1, DRB) during the demographic cycle of the water vole *Arvicola terrestris*. Positive historical selection was found to act very intensively on antigen-binding sites of MHC molecules in arvicolid rodents as documented by extensive trans-species polymorphism within the subfamily. For the first time within rodents, we documented the duplication of the DQA gene in three vole species with both copies being transcriptionally active [2]. We compared neutral genetic structure of seven populations (estimated from 14 microsatellites) with that estimated from MHC genes and we evidenced more intense selection on the gene DQA1 than on DRB or neutral markers and this pattern emphasized with increasing population abundance. In the year of low abundance, when populations were geographically isolated, overall differentiation patterns of both MHC genes were more pronounced than at neutral markers suggesting the action of local selection in fragmented populations. With increasing effective migration between sites the differences between MHC and neutral markers progressively vanished and in the high-abundance year, overall differentiation for DQA1 gene became even significantly lower than those of neutral markers, suggesting more homogenisation for that gene than what could be observed by chance for a neutral gene evolving under drift and migration only. Spatial and temporal fluctuations in parasite pressure are proposed as the most plausible mechanism inducing observed changes in contemporary selection pattern during demographic cycle [3].


Evolution of form and function in newts

Conflicts between structural requirements for carrying out different ecologically relevant functions may result in a compromise phenotype that maximizes neither function. Identifying and evaluating functional trade-offs may therefore aid in understanding the evolution of organismal performance. We examined the possibility of an evolutionary trade-off between aquatic and terrestrial locomotion in females of European species of the newt genus *Triturus*. Biomechanical models suggest a conflict between the requirements for aquatic and terrestrial locomotion. For instance, having an elongate, slender body, a large tail and reduced limbs should benefit undulatory swimming, but at the cost of reduced running capacity. To test the prediction of an evolutionary trade-off between swimming and running capacity, we investigated relationships between size-corrected morphology and maximum locomotor performance in females of ten species of newts. Phylogenetic comparative analyses revealed that an evolutionary trend of body elongation (increasing axilla-groin distance) is associated with a reduction in head width and forelimb length. Body elongation resulted in reduced maximum running speed, but, surprisingly, also led to a reduction in swimming speed. The
evolution of longer tails was associated with an increase in maximal swimming speed. We found no evidence for an evolutionary trade-off between aquatic and terrestrial locomotor performance, probably because of the unexpected negative effect of body elongation on swimming speed. We conclude that the idea of a design conflict between aquatic and terrestrial locomotion, mediated through antagonistic effects of body elongation, does not apply to our model system.


Species of the *Triturus cristatus* group showing the most prominent trend in body elongation and limb reduction within the (*Triturus*) clade.
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Research Priorities

The research of fishes is performed at various levels of spatial and biological organization (individual, population, and community), in relation to distribution, biology, ecology, and diversity. The study reflects the heterogeneity of aquatic environment, both in term of habitats and microhabitats, and the biodiversity between and within species. Fishes are considered to be complex bioindicators of degradation as well as regeneration of aquatic habitats. Accordingly, a number of activities are aimed at restoring and revitalisation of aquatic ecosystems.

Main research topics:
- diversity of fish communities and population parameters of key species in various types of aquatic habitats
- genetic diversity of fish populations
- rehabilitation of aquatic habitats and ecosystems for the restoration and conservation of fish biodiversity
- biology and conservation management of threatened species
- alien invasive species and their impact on native fish biodiversity
Selected research results

Growth characteristics of the barbel, *Barbus barbus*, in the middle course of the Jihlava River

Growth in length and weight, based on a combination of scale annulus interpretation and back-calculation using the Fraser-Lee model, was studied in male and female barbel, *Barbus barbus*, from a section of the Jihlava River sampled in 1999–2001. Results were compared with growth data obtained with similar methods in 1976, prior to construction and functioning of a hydropower scheme complex (Dukovany-Dalešice), and during the period of the scheme’s partial operation (1980–1984). Recent growth rate, under seemingly fully-established environmental conditions and complete adaptation of the barbel population, showed the highest values, especially in males. A distinct sexual dimorphism in growth rate was also confirmed, with females growing faster than males, though to a lower extent than recorded both during previous periods and from several other localities. Further, upon comparison of back-calculated lengths for previous years of recently tagged-and-recaptured fish (1999–2001), with observed lengths directly measured at corresponding ages, no significant differences were overall found between the results obtained by either method in most age groups. Finally, the linear Fraser-Lee model proved a sufficiently accurate and practical method for back-calculating lengths for previous years of life also in barbel.


Ichtyological investigation on the Jihlava River. Left to right: J. I. Namin, V. Baruš, L. Vetešník, M. Prokeš. (Photo by M. Peňáz)
Physiological and behavioural differences between *Carassius auratus* lineages differing in ploidy levels and parental origin

In recent years, original uniform (unisexual-triploid) populations of silver crucian carp in central Europe transform dramatically. Previous state of sporadic diploid individuals’ occurrence (both males and females) has been gradually substituted by current state, where on some localities these diploids begin to dominate. Main goal of our experiments is to understand factors which affect this dynamics of diploid-polyploid complexes.

The reactions of the individuals *Carassius auratus* on temperature and low-oxygen stress were observed. The results show differences in dependence not only on the ploidy levels but also on their ancestry. It may be an important selective factor in specific natural conditions which affected occurrence this groups in specific biotope. Haematological analysis was performed on 27 adult specimens of *Carassius auratus* irrespective of sex in 2003 and on 32 juveniles of distinguished sex in 2004. In this study we found that the ploidy level affected significantly ($p < 0.01$) the values of the erythrocyte count, mean corpuscular volume and mean corpuscular haemoglobin. Although we did not prove any significant effect of sex in juvenile diploids of *C. auratus* on the values of erythrocyte profile, the erythrocyte count, haematocrit value and haemoglobin content value were higher for males than for females. The erythrocyte count decreased significantly ($p < 0.01$) with increasing ploidy level. The index of haemoglobin content followed the same trend of a decreasing mean value with increasing ploidy level. Mean corpuscular volume and mean corpuscular haemoglobin increased with the increasing ploidy level ($p < 0.01$). Haematocrit value and mean corpuscular haemoglobin concentration did not significantly differ from the point of view of the ploidy level.

![Different depth preferences for swimming of diploid (left) and triploid (right) *Carassius auratus* in an aquarium. (Photo by K. Haláčka)](different_depth_preferences.jpg)
The nematode parasites of vertebrates: a potential sentinel species of heavy metal accumulation

To assess the bioindicator value of parasites, the concentrations of six heavy metals (Cr, Cu, Pb, Cd, Ni and Zn) were analyzed by atomic absorption spectrometry in pregnant females of the nematode Philometra ovata, body cavity parasites of gudgeon (Gobio gobio) and muscle samples of infected and uninfected hosts. The concentration of heavy metals was significantly higher in specimen of P. ovata compared to the host muscle tissue.

The parasite-to-muscle ratio of heavy metals varied from 3.2 to 121.7, in increasing concentrations for Cr, Cd, Cu, Pb, Ni and Zn. The presence of parasites did not influence the heavy metal content of the hosts, and no significant differences were found between muscle tissues of parasitized and non-parasitized fishes. The bioconcentration factor (BFs = C_{parasite} / C_{sediment}) varied between 0.4 and 25.8 and BFw (C_{parasite} / C_{water}) between 2133 and 25354. In conclusion the P. ovata – gudgeon parasite host system is an effective and practical bioindicator, even a sentinel system, of heavy metals load in aquatic ecosystems. Our results demonstrate that this parasite accumulates heavy metals at higher rates than the other nematode species (Anguillicola crassus, Contracaecum rudolphii, Protospirura muricola).


**Vimba vimba: a locally vanished and endangered species**

In the past, *Vimba vimba* was among the key components of the fish assemblages inhabiting the middle and lower reaches of streams in the Czech Republic. Dam building, water pollution, fragmentation of the longitudinal continuum of most rivers in the course of the 20th century has resulted in the fact that at present the species is classified as Vulnerable. The degree of its threatening differs in various drainage areas. The species is comparatively abundant in some parts of the Labe and Vltava drainage area (the Berounka River, the lower reaches of the Labe River, the confluence of the Malše and Vltava rivers). Recently, *V. vimba* has vanished from the drainage area of the Odra River. In the Morava drainage area, it is rather numerous in the middle and lower reaches of the Bečva River. Residual populations exist in the Dyje River upstream of the Vranov Reservoir and in the lower reaches of the Jihlava River.

Investigations on the remnant *Vimba* population in the Dyje River upstream of the Vranov Reservoir, carried out in 1934, have shown that it can survive for 70 years at a low level of its genetic diversity. The numbers of the adult component of this population does not exceed one thousand individuals. In view of the low mean age of the population, with just two age groups being responsible for reproduction, it has been recommended to foster the population with material obtained by hand-stripping and rearing individuals from that population.

Besides, another important measure to improve the status of *Vimba vimba* populations could inhere in successively renewing the migration permeability of streams in their longitudinal profile. Like *Chondrostoma nasus*, *Vimba vimba* is among the fish species that perform long-range spawning migrations.

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<th>Cr (mg/kg of dry matter)</th>
<th>parasite <em>P. ovata</em></th>
<th>host <em>G. gobio</em></th>
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The concentration of heavy metals in a specimen of *P. ovata* and the host *Gobio gobio* muscle tissue.
Characteristics of populations of the *Zingel zingel* and *Zingel streber* in the Czech Republic

*Zingel zingel* and *Zingel streber* are typical Danubian species occurring rarely in the Morava River drainage area within the Czech Republic. Due to weir constructions and especially due to increase of water pollution during the first half of the last century, they disappeared from our waters, and both species were assessed as critically endangered and protected by the national and European legislations. Only after improvements of the water quality in the Morava and Dyje Rivers, the new occurrence of *Z. zingel* was ascertained as early as in 1992, and that of *Z. streber* in 2003 in the area of the confluence of both rivers. A very numerous occurrence of young-of-the-year *Z. streber* specimens evidenced a successful reproduction.

The restoration of both species was enabled by constant improvements of the water quality and by possibilities of free migrations from the Danube through the Slovakian-Austrian part of the Morava River. The stable occurrence of both species is constrained at present to short sections (Morava r.km 70–74.1 and Dyje 0.0–26.7).

The karyotype of *Z. zingel* was analyzed. The diploid chromosome number was 2n=48 for the female, and only 2n=47 for the male, but there was also present a single large unpaired metacentric chromosome. This indicated the presence of the X1X1X2X2/X1X2Y multiple sex chromosome system produced by the fusion of two sub- or acrocentrics chromosomes, one of them being the sex chromosome Y.
Applications of Research Results

Removing of migratory barriers fragmenting large rivers

A weir in Břeclav, river km 27, constitutes the first migratory barrier for water fauna on the lower Dyje River, which has free migratory route to the Danube River through 70 km long...
Slovakian-Austrian stretch of the Morava River. At the end of 2005, a new fishpass was put into service within the frame of „Action plan of floodpass building on selected rivers of the Czech Republic“. During 2006, we conducted a monitoring of its function performance. It was stated that both the entrance and interior bouldered migratory parts are fully functional for whole species and age spectrum of fish community. From the aspect of fish migration it is necessary to optimize the upper part including the exit part of the fishpass. Feasible modifications (such as enlargement of entry slots and adding of 2–3 rows of boulders in upper parts) should allow full migratory passability for the whole species range of the lower Dyje River ichthyofauna.

Floodgate Střekov constitutes the first migratory barrier on the Elbe River (river km 321) on the territory of the Czech Republic. In 2001, the new lowland pool fishpass was built there in connection with the project „Salmon 2000“, allowing periodical monitoring of migrating fishes.

Significant numbers of juvenile (age 0+) and subadult (age 1+ and 2+) fish were observed migrating through a lowland pool fishpass from August to October in 2003 and 2004. Records of weekly catches totalled 2 148 (2003) and 6 469 (2004), mainly bleak, barbel, roach and dace. Fish migrated in the upstream direction probably to search the feeding grounds and refuges and their numbers corresponded to spring spawning migrations in the same fishpass and the year.


Building of fish pass on the Dyje River in Břeclav. (Photo by K. Halačka)
Artificial wetlands – significant support for stable fish biodiversity in a river alluvium

The natural dynamics of water discharges and the ensuing fluvial stream activity resulted in a considerable diversification of aquatic environments in fluvial ecosystems. Besides the active streams in flooding area, there originated and developed a diversified system of aquatic habitats. This hydrological system offered conditions for fish assemblages showing a high species richness. However, the modifications of most streams as well as other human activities resulted in a limitation or complete elimination of any fluvial activity of the streams. Therefore, new habitats are no longer created by the natural activity of water discharges and fluvial activity. On the contrary, the habitats created by the streams in the past are now gradually vanishing. Now there are two alternatives as regards the future of these habitats: either the existing natural habitats can be maintained and renewed by human efforts, or new habitats can be provided in the form of artificial wetlands (earth pits, channels, artificial pools and lakes). Alluvial habitats are irreplaceable environments for several indigenous fish species protected by native as well as European legislation: *Rhodeus amarus, Misgurnus fossilis, Cobitis elongatoides* incl. hybrid populations, *Umbra krameri* and, of other species, *Carassius carassius, Tinca tinca* and *Leucaspius delineatus*. Also, artificial wetlands can provide more stable environments for the survival of fishes during critical periods. Artificial habitats, connected with the main stream or flooded during floods are populated by species inhabiting the major stream. The artificial aquatic habitats lying outside the active alluvium can be provided with fish assemblages aimed at conservation goals. The highly positive contribution of artificial habitats in stabilizing populations of the species mentioned above has been demonstrated in concrete objects in the floodplains of the rivers Morava, Dyje, Lužnice and, in eastern Slovakia, the drainage areas of the Bodrog, Latorica, Tisza and Ondava rivers.


Two time stages of the artificial wetland in the Chomoutov Nature Reserve. (Photo by S. Lusk)
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Field laboratory in the town of Vidin, Bulgaria. Left to right: M. Vassilev, T. Trichkova, M. Ondráčková, M. Polačík, K. Francová, M. Dušková. (Photo by J. Huml)
Research Priorities

We use fish to investigate questions in ecology and evolution as well as applied issues in fisheries management, conservation of aquatic habitats and floodplain restoration. Our field and experimental studies are conducted in Europe, Asia and Africa. The current topics investigated in our department are:

• behavioural and evolutionary ecology of bitterling fish
• adaptation and coevolution of bitterling and their mussel hosts
• ecology, distribution and parasites of invasive Neogobius fishes
• 0+ juvenile fish community structure in lowland rivers and their flood plains
• optimisation of methods for 0+ juvenile fish sampling
• impacts of metazoan parasites on 0+ juvenile fish development
• community ecology of fishes in the Gambia River floodplain, Senegal, West Africa
• reproductive isolating mechanisms in the East African annual fishes Nothobranchius spp.

Selected Research Results

The coevolutionary relationship between bitterling fishes and freshwater mussels

Bitterlings (subfamily Acheilognathinae) are freshwater cyprinid fishes that have evolved an unusual spawning symbiosis with freshwater mussels from the family Unionidae. Female bitterling develop long ovipositors that they use to place their eggs deep inside the gill cavity of a mussel and males fertilise the eggs by releasing sperm into the inhalant siphon of the mussel. Bitterling embryos develop inside the mussel gill cavity for weeks and constrain mussel physiology. In turn, unionid mussels have parasitic larvae called glochidia. They are released into the water column, attach to fish gills or fins and obtain nourishment from the fish host. We found that relationship between bitterling and mussel, popularly considered mutualistic on the premise that bitterling use mussels as spawning sites while the mussel benefits by using bitterling to disperse their glochidia, is more complex.

We investigated the costs and benefits from the symbiosis to both fish and mussels and found that in Europe, bitterling are parasites of mussels. European bitterling do not host glochidia, but adult European mussels suffer from a reduction in growth and fecundity if they carry bitterling embryos. In a further study, we found that this may be due to a lag in the coevolutionary relationship - bitterling presence in Europe is recent and mussels may have not had enough time to evolve sufficient adaptations. Indeed, in Asia, where bitterling origin is ancient, mussels are able to eject bitterling eggs and embryos prematurely, similarly to the eviction of cuckoo eggs by their bird foster parents. In a large scale comparative study in China, we discovered that the bitterling species vary in the level of their specificity to particular hosts and revealed a complex network of relationships between bitterling and mussel traits.

Sexual selection in the bitterling fish: the role of female choice and male mating tactics

Natural selection theory is based on the principle of unequal individual reproductive success within a species. This is caused by differential survival among individuals (ecological adaptations) and different number of offspring produced by individuals (sexual selection). Sexual selection explains the evolution of adaptations to maximise the individual reproductive potential, particularly adaptations to male-male interference competition for females and female choice. Using a series of experiments with a small cyprinid fish, the European bitterling, *Rhodeus sericeus*, we separated the two components of sexual selection and investigated their relative importance by estimating male reproductive success through paternity assignments. For individual males, the success in male-male competition for territories was significantly
more important than female preference of a given male. Dominant males monopolised access to territories and sired considerably more offspring than males preferred by females. Therefore, the hierarchical rank of males reduced opportunities for female choice and females, despite being choosy, had limited control over the paternity of their offspring. In another set of experiments, we found that female bitterling may use sophisticated behaviour to prolong the spawning act and solicit sneaking fertilisations from subordinate males. This behaviour enables preferred, but subordinate, males to sire some offspring. Our data suggest new prospect in explaining the evolution of alternative male reproductive tactics, so far considered as a “parasitic” strategy undermining female choice.

Our results show that alternative male tactics may, contrary to the current view, augment rather than decrease the role of female choice. Given the important consequences of this finding on effective population size, our results have also general implications in the management of natural populations.


**Sampling methodology and monitoring of 0+ juvenile fish in channelized lowland rivers**

Fish reproduction and use of nursery habitats by 0+ fish have been long-term monitored (1991-2006) in lowland channelized and regulated river Morava (r km 69.4–92.8). At twenty localities within the river stretch, 0+ juvenile fish assemblages are sampled in late summer by point abundance sampling (PAS) electrofishing.

PAS is widely used sampling strategy based on collecting numerous small (point) samples of the same size. This principle is considered to be more statistically robust than sampling low number of large samples. To evaluate its suitability for monitoring 0+ juvenile fish assemblages, we compared PAS with a strategy that surveys the given area in its whole length: a continuous sampling. Both strategies provided similar estimates of 0+ juvenile fish assemblages, in terms of species richness, species composition, relative proportion of the most abundant species and size structure. PAS proved to be the less time-demanding strategy (consuming approximately 60% of time compared to CS) allowing either surveying the fixed area quicker than CS or surveying longer area within fixed time interval. We therefore evaluated PAS as an appropriate strategy for sampling 0+ juvenile fish in lowland channelized rivers.

Though the lower part of the Morava River was modified for navigation, it is currently not used for this purpose. Therefore a variable water discharge is allowed to occur, which creates more habitat variability. The riprap bank is a uniform bank type occurring along the shoreline. Gently sloped sand-gravel beaches are formed along the inner bands of the river during low summer discharges. During periods of elevated discharge, the water level reaches the bankside vegetation above the boulder bank. All these habitat types are, according to our results, suitable for, and to a large extent utilized by, the 0+ juvenile fish assemblage.

Mainly bitterling, chub, bleak, and gudgeon have adapted to the conditions following river modification and form abundant and stable populations. These species reproduce successfully and form a major part of the 0+ fish community. Specialist species (phytophils and most of lithophils) are disadvantaged, in term of their reproductive success.


**Applications of Research Results**

**Water Framework Directive implementation**

Since 1999, we have provided monitoring of young-of-the-year fishes in selected profiles of the river network that were included in the water quality assessment program in the Czech Republic (coordinated by Water Research Institute TGM Praha). In 2005, National Methodology for fish monitoring program within WFD implementation, based on international sources (FAME, CEN), has been completed and tested. During 2006, this methodology has been used in monitoring of 174 sites. The monitoring of young-of-the-year fish has been proven as a suitable methodology for WFD evaluation in the intensively stocked rivers in the Czech Republic.

International Cooperation

Distribution, ecology and parasite fauna of zebrafish (*Danio rerio*) in Bangladesh

Zebrafish, *Danio rerio*, is a well established laboratory species in biomedical research. It has proven to be hugely influential in studies on gene expression of physiological, morphological and behavioural traits. There are surprisingly few data available on zebrafish natural behaviour and ecology. We have participated in an expedition that collected data on geographical distribution, habitat preferences, population structure and parasite load of wild zebrafish in Bangladesh. We found that zebrafish inhabits standing water bodies within the floodplain rather than river environment and that it is the most abundant in shallow lakes, ponds and ditches with rich vegetation at the margins. It is commonly abundant in water bodies with a connection to rice cultivation. We have identified parasite fauna of zebrafish based on a dissection of 120 individual zebrafish and eight additional fish species co-occurring with zebrafish. Our results suggest that there are large differences in parasite abundance and species richness among zebrafish populations from across Bangladesh which may be used in subsequent studies linking genetic background and susceptibility to parasitic diseases.

This project is based on the international cooperation with University of Leicester (United Kingdom), University of Khulna and University of Mymensingh (Bangladesh).


Field research in Bangladesh. (Photos by M. Reichard and C. Pateman Jones, respectively)

Distribution, ecology and parasites of *Neogobius* fishes in their native and non-native area of distribution

Four Ponto-Caspian gobies of the genus *Neogobius* are regarded as invasive species because of their ability to rapidly establish abundant populations in the non-native areas, as was
documented in Europe and North America. In the non–native range, *Neogobius* spp. may affect local ecosystem directly e.g. by changing food web interactions, or indirectly by acting as a vector for non–native parasites. To explain the successful introductions of *Neogobius* spp. in the Danube River basin, we investigated their distribution, ecology and parasites in both native and non–native range (lower and middle Danube, respectively). We found that *N. melanostomus* and *N. kessleri* dominated in the non-native range whereas *N. fluviatilis* dominated in the native range. Our results of fish distribution support the hypothesis of disjunctive spreading since very low population densities of *N. gymnotrachelus* and especially *N. melanostomus* were registered in the Croatian section of Danube, i.e. in the middle between native and non-native abundant populations. *N. gymnotrachelus* was relatively rare in both examined Danube stretches. *N. kessleri* and *N. melanostomus* reached a bigger size in the non–native area and some differences between populations were found also in the diet.

Parasite fauna of native and non-native populations of *N. kessleri* and *N. melanostomus* showed slight differences in both parasite abundance and parasite species richness. Parasite community in riverine fish did not differ among populations especially in *N. kessleri*; on the other hand, in fish from side-arm system, a habitat untypical for this fish species, the parasite species richness was two times higher than in the river. Parasite fauna of *Neogobius* spp. comprises mainly common and abundant parasites in the particular site showing very low host – specificity. Ponto-Caspian gobies seem to be fish hosts very susceptible to various parasite species and their parasite community reflects the fish feeding strategy and habitat preference.

This project is based on the international cooperation with Bulgarian Academy of Sciences (Bulgaria), University of Osijek (Croatia) and University of Vienna (Austria).


Racer goby Neogobius gymnotrachelus. (Photo by P. Jurajda)
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Research priorities

Our research focuses on understanding the ecological and evolutionary basis of reproductive strategies. Important goals of this research are to identify the ecological factors that promote parasitic reproductive behaviour, predator avoidance and nest predation. We conduct studies adopting the adaptationist and optimality approach of behavioural ecology to examine fitness costs and benefits of various characters in bird populations. Further we aim at understanding the evolution and signalling function of secondary male ornaments in birds. Using genetic markers we study population differentiation and phylogeography of selected European passerines across migratory divides which are inferred from measurements of stable isotope ratios and ringing recoveries. Our current research also concentrates on patterns of singing activity in passerines and includes studies of parasites associated with birds of the Afrotropical and Neotropical Regions as well.

Selected research results

Extra-pair fertilizations and mechanisms of mate choice

Extra-pair fertilizations (EPF) are frequently documented in songbirds. A costs–benefits approach has frequently been used to understand the evolutionary origin and maintenance of promiscuity in this group. Recent meta-analyses suggest that direct costs to unfaithful females outweigh indirect benefits from infidelity in socially monogamous songbirds, what
indicates that in these taxa, EPF evolved primarily as a self-interest male tactic. We performed a comparative analysis to show that standardized selection gradients acting against female infidelity (direct costs of promiscuity) explain variation in EPF rates at an interspecific level in passerines. This result confirms that costs to females resulting from reduced parental care by cheated males constrain promiscuity in this group. Our data indicate that females exert resistance over EPF when the costs of infidelity are high and, conversely, that the rate of EPF increases when selection on females to defend themselves against EPF attempts by males is weak and costs of infidelity are low. Indirect (genetic) benefits to females should play a central role in choice of extra-pair mate, since female birds do apparently obtain only sperm from these mates. There are two basic models of mate choice in animals, with indicator model proposing an absolute criterion of mate choice such as sexual ornaments, and the other one proposing (dis)similarity between the female and male as the main mechanism. The latter is often called choice of ‘genetic compatibility’ in recent literature. However, the term ‘genetic compatibility’ has an existing meaning in speciation and we therefore propose use of the term ‘genetic complementarity’ over ‘genetic compatibility’. This is in agreement with Trivers (1972) who was to our knowledge the first to clearly articulate the phenomenon of mating based on genetic dissimilarity.


**Coevolution between European hosts and their brood parasites**

Successful adaptations and counteradaptations by avian brood parasites and their hosts provide some of the best examples of direct coevolution in nature. Successfully parasitized hosts often raise only the cuckoo young and have zero reproductive success. This creates conditions for coevolutionary arms race between hosts and parasites. We studied both adaptations of the hosts and counteradaptations of the parasites, respectively.

We tested experimentally responses of the hosts towards multiple cuckoo parasitism and suggest that when the parasitism rate reaches high levels, e.g. at the beginning of the coevolutionary arms race, defense against multiple parasitism may be an important component of host’s adaptation to brood parasitism in general. Other major adaptations are those related to the parasitic egg. We evaluated the puncture resistance hypothesis for the occurrence of thick-shelled eggs in common cuckoo by investigating costs of cuckoo egg ejection in four *Acrocephalus* warblers. Last but not least, we tested great reed warbler discrimination against two cuckoo morphs in two areas with different parasitism rates and proportions of the two morphs. Our results suggest that both local parasitism pressure and relative abundance of the two colour morphs of a brood parasite may significantly influence host defences. Finally, we studied laying strategy of cuckoo that is well-synchronized with that of the host. This matching of laying patterns with those of the hosts suggests an adaptive response to ensure optimal hatchability of the cuckoo eggs and to avoid multiple parasitism of the same nest even under heavy pressures of brood parasitism.

Savi’s warbler: A model species for studying the patterns of singing activity

Males of many bird species spend enormous amounts of time singing, which may amount to several hundred thousand songs per season. They sing in order to acquire a mate and to defend a territory and its resources or to minimize the risk of cuckoldry by neighbouring males and to maximize the probability of their own successful extrapair copulations. Diel patterns of singing vary among bird species in aspects such as the timing of peaks through the day or night and throughout the season.

We studied seasonal and diel patterns of singing activity of Savi’s warblers *Locustella luscinioides* in two areas of Central Europe 300 km apart, over a period of 18 years. We assess about 4,600 records of individuals singing. Males were found to exhibit similar singing activity in both study sites. They started to sing after arrival at the beginning of April and peaked from the end of April to the beginning of May. Thereafter, their singing activity was lower but more...
stable for a relatively long period from mid-May to mid-July. At the end of July, males sang only sporadically and singing activity ceased at the beginning of August. At the beginning and towards the end of the song-period males sang sporadically whereas in the period of the highest singing activity they sang over the entire 24-h period. During the whole song-period, there was a significant difference in singing activity between daylight and the dark (67.2 and 32.8%, respectively). However, the period of daylight was longer. Average singing activity showed similar levels in daylight and the dark with mean numbers of 5.9 and 6.6 males per hour, respectively. Major changes in singing activity were related to the twilight periods. There were distinctive dawn and dusk choruses. In the morning, Savi’s warblers exhibited similar levels of singing activity over 3 h of the dark before twilight, singing reached its highest level at twilight and 1 h after twilight. During the evening, singing activity reached its highest–level 1 h before twilight, while during twilight it was decreasing, with a considerable decline 1 h after nightfall.


International cooperation

Coevolution between an African brood parasite and its hosts

The red-chested cuckoo parasitizes many passerines in Africa, but some common species sympatric with the brood parasite are rarely used as hosts. Since very little is known about
brood parasitism on this continent, we experimentally tested responses of three turdid hosts to parasitism with artificial cuckoo egg. Our results support the hypothesis that rejection behaviour in two species (olive thrush, Kurrichane thrush) evolved as defence against interspecific parasitism, with thrushes appearing to be ahead in the host–parasite arms-race. The Cape robin, by contrast, appears not to reject cuckoo eggs, either because it is unable to recognize them, or because the cost associated with removal may be too high.

This study was made in collaboration with the University of Stellenbosch (Matieland, South Africa) and it was supported by a John Ellerman Fellowship.


Parasites associated with birds native to rainforests on the Caribbean slope of Costa Rica

We undertook our research of ectoparasites on birds of the Cordillera de Talamanca mountain range in Limón province, southeastern Costa Rica. In the rainy season of 2004 (August through September), we sequentially studied birds at two locations (Hitoy Cerere Biological Reserve and Barbilla National Park) on the Caribbean slope differing in elevation and habitat character. A total of 530 individuals of 79 bird species were examined. In this contribution we focus on chewing lice (Phthiraptera) and mites (Acari: Macronyssidae) associated with hummingbirds (Trochilidae), typical antbirds (Thamnophilidae), ground antbirds (Formicariidae), manakins (Pipridae) and grosbeaks (Cardinalidae) inhabiting lowland tropical rainforests.

M. Čapek examining a long-tailed hermit Phaethornis superciliosus in the laboratory of Hitoy Cerere Biological Reserve, Costa Rica, August 19, 2004. (Photo by M. Havlíček)
We found five chewing lice species belonging to the genera *Formicaphagus*, *Machaerilaemus* and *Myrsidea* of which three are the species new to science. They and their type hosts are as follows: *Formicaphagus tyrannina* ex *Cercomacra tyrannina* (Thamnophilidae), *Myrsidea mcleannani* ex *Phaenostictus mcleannani* (Thamnophilidae) and *Myrsidea klimesi* ex *Formicarius analis* (Formicariidae). These are the first records of *Myrsidea* from members of the passerine families Thamnophilidae and Formicariidae. Mites were represented by three species of the genus *Pellonyssus* of which *P. cyanoides* from *Cyanocopsa cyanoides* is the species new to science.

Scientists from the University of Veterinary and Pharmaceutical Sciences in Brno, the Institute of Vertebrate Biology AS CR in Brno, the Institute of Parasitology AS CR in České Budějovice (Czech Republic) and the University of Queensland in Brisbane (Australia) collaborated on the work. We are grateful to the Ministerio del Ambiente y Energía de Costa Rica for permission to conduct our study.


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Research priorities
Research is focused on the ecology of selected mammalian groups. The results of investigations are aimed to improve management of forest stands, game management, rodent pest control, and protection of biodiversity.
Main research topics:
• feeding ecology of large herbivores and their impact on vegetation
• foraging ecology and anti-predator strategies of bats
• ecology and behaviour of large carnivores, and foraging ecology and distribution of mustelids
• synecology of small terrestrial mammals
• diversity and ecology of small mammals and ungulates of West Africa

Selected research results

Structure and diversity of small mammal communities in agriculture landscape

Result of six year trappings (51,480 trap/nights, total catch 5,536 small terrestrial mammals) in various field crops and other habitats in a poorly wooded agricultural landscape of southern Moravia (Czech Republic) were presented. Fourteen small mammal species were captured; the relative population density and dominance of each species in each crop and other habitats were evaluated. According to Renkonen’s index of similarity small mammal communities could be divided into two main groups: the first comprised windbreaks, small woods and fallow land with high dominance of species with affinity to forest environment; the other group is formed by open habitat communities. These were again divided into two groups: perennial crop group (as alfalfa) and one-year crop group (as corn, sugar beet, maize, and other crops). In the first group with forest affinity a higher diversity of small mammal community compared to second, open habitat one has been found. Changes of diversity index values according to the agrotechnical changes were also evaluated.


Relative abundance and community structure in spring+summer (S) and autumn+winter (W) samples in habitats studied. Cgla – Clethrionomys glareolus, Marv – Microtus arvalis, Mmus – Mus musculus, Asyl – Apodemus sylvaticus, Amic – A. microps, Afa – A. flavicollis.
Density and distribution of deer in a floodplain forest

Data on the density and distribution of deer help to protect artificial plantations and naturally regenerating stands against browsing damage, to select suitable additional feeding places and to assist in rational game management. Habitat selection by deer is best viewed as a trade-off between selection of cover and selection of food. High primary production, high biodiversity of the floodplain forest ecosystem and agricultural fields situated along the forest offer very specific conditions, which can significantly influence habitat selection of deer species living there. We analysed density and distribution of red deer and roe deer in relation to habitat structure and distribution of food sources during winters 2001–2004 in a floodplain forest along the Morava River. Densities of both species were relatively high (red and roe deer, 9.6 and 7.0 ind./km$^2$ respectively). Red deer preferred forest stands with dense cover (60–80 %) and a diversified shrub layer (more than three tree species). Roe deer mainly used old stands of age 50–99 years with a high cover of canopy layer and conversely low cover of herb layer, dominated by bramble. A positive relationship between the distributions of both species was detected. Inter-specific spatial interference was not observed, despite their high densities in the study area.


![Graph showing density of red and roe deer in different types of stands.](image_url)

Average values of the roe and red deer density (individual/km$^2$) in forest stands of different age and in meadows.

Flight activity of bats during non-hibernation period

We studied the flight activity of bats under three different conditions: a) emergence and return activity of bats in maternity colonies [1], b) foraging activity of bats [2 and 3], and c) flight activity in the entrance of natural karstic cave [4].

Parameters of return activity generally occurred at lower light intensities than those of emergence at six maternity colonies of pipistrelle bats (Pipistrellus pipistrellus and P. pygmaeus) in NE Scotland. Therefore, the interval between dawn return and sunrise was generally longer.
than that between sunset and dusk emergence. Emergence and return were equal in duration. Bats clustered more on emergence in comparison with return during pregnancy and lactation, whereas during postlactation this trend was reversed [1].

The foraging activity of bats was studied in karstic area and various natural forests. Bat detectors were used to record echolocation calls of bats on line transects during the first half of the night. *Myotis daubentoni* was the most numerous species. The number of bat species was the highest in rocky habitats, and the lowest in agrocoenoses. The greatest intensity of flight activity of the bat community was observed over ponds and streams [2]. Generally, the level of flight activity of bats detected in lowland forests was significantly higher compared to the activity in mountain forests. The highest activity was recorded in the floodplain forest. On the contrary, the mountain spruce forest was utilized by bats only scarcely. In lowland forests, the highest activity was registered in the pregnancy period and it gradually decreased towards the end of the season. In mountain forests, the level of activity was rather well-balanced throughout the season. In spite of that the lowest activity was obtained in pregnancy period. In all forest habitats, the flight activity was higher at the beginning of the night than before midnight [3].

Activity patterns of bats were recorded automatically with a double infrared light barrier at the entrance of Kateřinská cave (Czech Republic) too. Five periods were defined on the basis of bat flight activity. All periods showed a non-random temporal distribution and a concentration of flight activity around specific time. There was a positive correlation between the number of bat passes through the entrance and outside ambient temperature and a negative correlation between the number of passes and barometric pressure. Rain had no significant effect on the level of bat activity [4].

*Křivé Lake (floodplain forest) where the highest bat flight activity was recorded. (Photo by Z. Řehák)*

**Applications of Research Results**

**Evaluation of game damage to the field crops**

Field crops are extensively damaged by large herbivores in many localities of the Czech Republic. To judge the impact of herbivores on the yield of crop, plants at an early stage of development were experimentally clipped to simulate browsing varying in intensity. In some fields we evaluated the extent and economic effect of wild herbivore damage on main field crops. We also analysed and developed a new method for assessing the damage to crops. The manual elaborated features free living game which cause serious damage to field crops. Pictures of main types of damage to crops are also included.

In general, damage to leaves caused only a small reduction of the yield. Winter wheat or barley crops were not influenced by a considerable reduction of leaves. Only yield of sun flower and winter rape was significantly lower in defoliated plants. Crop damages at the later stages of plant development were more important. In fields connected to the forest edge 5–50% plants were damaged. Our method allows to make accurate estimates of the extent of damages. The study provides practical guidelines for state agencies, wildlife managers and farmers.

Wild boar rooting in a pasture. (Photo by J. Kamler)
International Cooperation

Feeding behaviour, parasite infections and self-medicative abilities of an introduced chimpanzee population

The chimpanzee population on Rubondo Island results from an introduction of 17 individuals in the late 60ties and it is the only example of a viable, long-term self-sustaining released chimpanzee population with a minimum of human intervention at the time of release and afterwards. Our on-going research is aimed to study these chimpanzees as a model population adapted to a new environment from the aspects of feeding behaviour, self-medication, and parasite exchange among released chimpanzees and colobus monkeys (Colobus guaraza) and indigenous velvet monkeys (Cercopithecus aethiops). Obtained results will contribute to our understanding of chimpanzee behavioural and ecological flexibility and are supposed to help to increase the success of next releases.

We examined the relationship between fruit availability, dietary composition and grouping in the descendents of an introduced chimpanzee population on Rubondo Island. Tree fruit
availability was positively correlated with rainfall, with a period of relative tree fruit scarcity corresponding with the long dry season. Liana fruit availability was not related to rainfall, and lianas exhibited more stable fruiting patterns across seasons. Fruits made up the majority of chimpanzee diet, with lianas accounting for 35% of dietary fruit species. Fruits of the liana *Saba comorensis* were available during all months of phenological monitoring, but they were consumed more when tree fruit was scarce, suggesting that *S. comorensis* fruits may be a fallback food for Rubondo chimpanzees. There were no increases in consumption of lower-quality plant parts between seasons, and there were no changes in nesting group size between seasons. These results contrast with evidence from several endemic chimpanzee study sites, and indicate that Rubondo chimpanzees may experience fewer ecological constraints on dietary quality and grouping patterns.

We identified three nematode species not previously reported in chimpanzees (*Pan troglodytes*) introduced on Rubondo Island, Tanzania: *Protospirura muricola*, *Subulura* sp., and *Anatrichosoma* sp. The chimpanzee pinworm, *Enterobius anthropopitheci* was redescribed based on light and scanning electron microscopy of both sexes collected from the feces of Rubondo chimpanzees.


Mother and baby chimpanzee. (Photo by K. J. Petrželková)
Body proportion and bone biomechanics of the Tyrolean “Iceman” (Ötzi)

Body mass and structural properties of the femoral and tibial midshafts of the “Iceman” (Ötzi), a late Neolithic (5200 BP) mummy found in the Tyrolean Alps, are determined from computed tomographic scans of his body, and compared with those of a sample of 139 males spanning the European Early Upper Paleolithic through Bronze Age. Two methods, based on femoral head breadth and estimated stature and bi-iliac (pelvic) breath, yield identical body mass estimates of 61 kg for the Iceman. In combination with his estimated stature of 158 cm, this indicates a short but relatively wide, or stocky body compared to our total sample. His femur is about average in strength for Neolithic males, but his tibia is well above average. His femur also shows adaptations for his relatively broad body (mediolateral strengthening), while his tibia shows adaptations for high mobility over rough terrain (anteroposterior strengthening). In many respects his tibia more closely resembles those of European Mesolithic rather than Neolithic males, which may reflect a more mobile lifestyle than was characteristic of most Neolithic males, perhaps related to a pastoral subsistence strategy. There are indications that mobility in

Transverse CT scans through pelvic region (a) and CT scans of femoral heads used for body size estimate (b) (Iceman, 5200 B.P.). Left femur is postmortem dislocated from acetabulum.
general declined between the European Mesolithic and Neolithic, and that body size and shape may have become more variable throughout the continent following the Upper Paleolithic.

The research was leaded by Christopher Ruff (Johns Hopkins University School of Medicine) with cooperation from United States (Brigitte Holt, University Massachusetts; William A. Murphy, University of Texas), Czech Republic (Vladimír Sládek, Institute of Vertebrate Biology) and Austria (Margit Berner, Naturhistorisches Museum; Dieter zur Nedden, Wolfgang Recheis, University of Innsbruck; Horst Seidler, University of Vienna).

OBITUARY

Zdeněk Veselovský
(1928–2006)

Professor Zdeněk Veselovský was a distinguished zoologist who was a source of great inspiration to generations of ornithologists, mammalogists, and behavioural biologists in the Czech Republic. He was born in Jaroměř on 26 August 1928 and died on 24 November 2006 in Prague.

Zdeněk Veselovský was a naturalist of very broad competence, and his skills for popularization of the animal world to wide public were particularly recognized and appreciated. He was the author of more than 100 research papers and he published 35 books and textbooks. He had worked for almost 30 years as the director of the Prague ZOO (1959–1988), and he was later appointed as the professor of zoology at universities in České Budějovice and Prague.

He was a research fellow of the Institute during a short period in 1992 and 1993. This employment, provided by the Academy of Sciences, was quite important for Zdeněk Veselovský, because it enabled him to continue his scientific career in uneasy times of his life.

Zdeněk Veselovský was a man with great enthusiasm, curiosity and love of nature. His deep knowledge and warm friendly personality will be greatly missed by many.
AWARDS

In 2004, Zdeněk Hubálek was awarded the Prize of the Academy of Sciences of the Czech Republic for his studies on biology of West Nile virus, the agent of encephalitis in some vertebrates including humans. The results were published in 17 scientific papers and received a wide international response (the principal 1999 paper has been cited 224 times up to February 2007). Zdeněk Hubálek’s long-term research concentrates on the ecology of arthropod-borne viruses and bacteria pathogenic for vertebrates, such as arboviruses and Lyme disease borreliae, and his papers have been cited almost 1 400 times. He has been assessing potential role of free-living birds in dispersal of pathogenic bacteria and viruses and is involved in the EDEN project of the 6th Framework Programme (West Nile virus, tick-borne diseases). Z. Hubálek is a member of two expert commissions of WHO.

In 2005, Martin Reichard was awarded the Otto Wichterle Prize for his studies on general processes in population, behavioural and evolutionary biology. He uses fishes as a model group. His current research has concentrated on the evolution of reproductive strategies and mating systems, co-evolutionary dynamics and the effect of individual behaviour on population processes. He further investigates the ecology of early developmental stages of fish with a special attention to larval dispersal and the effects of biotic and abiotic factors on the success of natural reproduction. He is also involved in several projects on the ecology of tropical fishes in Senegal, Bangladesh, and China.
In 2006, the rector of Czech University of Agriculture in Prague awarded Vlastimil Baruš, director of the former Institute of Vertebrate Zoology and the Institute of Systematic and Ecological Biology CS AS, a commemorative medal which was struck in honour of the 100th anniversary of the university.

The Otto Wichterle Prize award ceremony 2005. Martin Reichard (left) receives the Otto Wichterle Prize for young scientists from the president of the Academy of Sciences of the Czech Republic Václav Pačes (right). Photo by M. Hužvárová.

Commemorative medal of Czech University of Agriculture in Prague.
INTERNATIONAL ACTIVITIES

The Institute’s international collaboration is a very important part of its all research activities. Our scientists work in close collaboration and exchange their views with scholars from various institutions in many countries. Each department is involved in various forms of international co-operation and we have recently been participating in 20 international projects including six projects within the EU Sixth Framework Programme. We have been deriving much benefit from established links with foreign laboratories, however, we use any opportunity to find new contacts. The Institute organizes scientific meetings, offers study visits to foreign students and supports participation of our specialists in major scientific events abroad. Great emphasis is placed on young scientist-centred educational stays. Our scientists are members of 38 international organizations and 8 editorial boards, respectively.

International scientific meetings organized by the Institute

• 8th SE European Bird Migration Network Workshop, Prague, Czech Republic, February 2–5, 2006

The 8th Workshop of Southeast European Bird Migration Network (SEEN) was jointly organized by the Institute of Vertebrate Biology and the Faculty of Science of Charles University. SEEN workshops present a fruitful discussion platform for investigators of avian migration along the less studied southeastern European flyway. A total of 46 participants from 15 countries attended the workshop. The majority of the studies reported on results of orientation experiments, however, several participants demonstrated that also other approaches, such as satellite telemetry or stable isotope analysis are being adopted. These modern methods have challenged the traditional view of avian migrations and enable to answer hitherto unthinkable questions. An important lecture was held by Zdeněk Hubálek from the Department of Medical Zoology, Institute of Vertebrate Biology of the ASCR on avian influenza, followed by a discussion how the network could contribute to the understanding of possible spread of the H5N1 virus. The next workshop will be held in Kraków in 2007.

• Conference “Zoologické dny 2006” [Zoological Days 2006], Brno, February 9–10, 2006

Long-term tradition of the “Zoological days” conference goes back to 1969 and it is connected with the Institute of Vertebrate Biology and the former Institute of Vertebrate Zoology. Nevertheless, its scope and contents has changed as all lifestyle in the Czech Republic after the velvet revolution in 1989. Former meeting of Czech and Slovak zoologists serving as forum of the Czech Zoological Society (co-organizer) became a serious yearly scientific conference where mainly students and young researchers present actual results of their research focussed on various aspects of both vertebrate and invertebrate zoology. The student competition is organized thanks to the sponsorship of the OLYMPUS company which became a regular co-operative partner of the conference. In 2006, six students received awards for their outstanding presentations. Since students presented at least half of all posters and lectures (total number of presentations: 143 lectures and 136 posters) this sponsorship was a great help. Since 2003, the conference has been held at the Faculty of Science, Masaryk University Brno (co-organizer) and approximately 350 both professional and amateur zoologists from the Czech and Slovak Republics participated in it every year.
Participation in international conferences

- ESF BIRD Final Conference, Wilhelmshaven, Germany, February 16–20, 2005
- Man and Biosphere Meeting, Simenti, Senegal, March 1–2, 2005
- Annual International Symposium FSBI: Fish Habitat Ecology and Conservation, Bangor, Wales, United Kingdom, July 18–22, 2005
- 9th International Congress of Mammalogy, Sapporo, Japan, July 31 – August 5, 2005
- 10th Congress of European Society for Evolutionary Biology, Krakow, Poland, August 15–20, 2005
- 29th Ethological Conference, Budapest, Hungary, August 20–27, 2005
- 5th Conference of the European Ornithologists’ Union, Strasbourg, France, August 20–23, 2005
- 10th European Bat Research Symposium, Galway, Ireland, August 21–26, 2005
- 13th Meeting of the International Hamsterworkgroup, Illmitz, Austria, October 14–17, 2005
- 5th Asia-Pacific Congress of Entomology, Jeju, South Korea, October 18–21, 2005
- European Otter Workshop, Padula, Italy, October 20–23, 2005
- Ecology of Stream Fish: State of the Art and Future Prospects II, León, Spain, June 12–16, 2006
- EIFAC International Symposium, Mondsee, Austria, June 12–17, 2006
- Genetics of speciation, Vancouver, Canada, July 21–24, 2006
- Behavioral Ecology Congress, Tours, France, July 23–30, 2006
- International Congress of Parasitology, Glasgow, United Kingdom, August 6–11, 2006
• 24th International Ornithological Congress, Hamburg, Germany, August 13–19, 2006
• 36th International Conference, International Association for Danube Research, Vienna, Austria, September 4–8, 2006
• Applied Ornithology 2006, Zvolen, Slovakia, September 8–9, 2006

Membership in international organizations

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<tr>
<th>Name</th>
<th>Organization and Position</th>
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<td>ALBRECHT T.</td>
<td>International Society for Behavioral Ecology (ISBE)</td>
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<td>BARUŠ V.</td>
<td>Sociedad Cubana de Parasitología Animal, honorary chairman</td>
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<td>BÍMOVÁ B.</td>
<td>International Mammalian Genome Society</td>
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<td>BRYJA J.</td>
<td>Steering Committee of European Science Foundation</td>
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<td>ČAPEK M.</td>
<td>IOC Standing Committee on Ornithological Nomenclature</td>
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<td>ČERVENÝ J.</td>
<td>Ad Hoc Group for Environmental Problems of COST</td>
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<td>(Council for Research and Development, EU)</td>
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<td>Czech National Committee of the MAB Programme</td>
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<td>Societas Europaea Mammalogica</td>
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Membership in editorial boards

BARUŠ V.  Transactions of the Zoological Society of India
           Helminthologia
BŁAHÁK, P.  Folia Zoologica (managing editor)
GVOŽDÍK, L.  Folia Zoologica
HONZA M.  Folia Zoologica
HUBÁLEK Z.  Cryobiology
           Folia Parasitologica
KOUBEK, P.  Folia Zoologica
LUSK S.:  Folia Zoologica
PEŇÁZ M.  Folia Zoologica (editor-in-chief)
           Quaderni E.T.P. – Journal of Freshwater Biology
           Polskie Archiwum Hydrobiologii
SLABÁKOVÁ H.  Folia Zoologica
ZIMA J.  Hystrix – Italian Journal of Mammalogy
           Folia Zoologica
EDUCATION AND TEACHING ACTIVITIES

The Institute lays great emphasis on education and teaching activities. In 2005–2006, we gave lectures at seven faculties of seven universities and supervised 61 undergraduates and 53 postgraduates from 11 faculties of eight universities. Another important fact is that 19 and 9 students supervised by the staff succeeded in obtaining their MSc and PhD degrees, respectively. We have accreditation from the Ministry of Education, Youth and Sports of the Czech Republic to perform post-gradual studies in zoology at the Faculty of Science, Masaryk University in Brno, and the Faculty of Biological Sciences, South Bohemian University in České Budějovice. We participate in research projects carried out in two joint laboratories, "Evolutionary Genetics of Animals" (established by the Department of Zoology, Faculty of Science, Charles University in Prague, the Institute of Animal Physiology and Genetics AS CR in Liběchov and the Institute of Vertebrate Biology in Brno) and “Ichthyoparasitology - The Centre of Basic Research” (established by the Faculty of Science, Masaryk University in Brno and the Institute of Vertebrate Biology in Brno). These laboratories provide a firm basis for better interaction between the Academy of Sciences CR and universities, which helps to make the institute attractive to students. Moreover, the scientists of the Institute are members of scientific councils and boards at universities.

Teaching at universities

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### Undergraduate students working in the Institute and/or supervised by the Institute’s fellows in 2005–2006

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2. Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry, Brno
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